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ON THE RESISTANCE OF TEGURIAMI FISHING VESSELS.

By

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The 2nd experiments for determining the resistance of fishing boats were conducted in the experimental tank of our institute upon the boats used for the teguriami fishing. The vessels used were 8 in number, and were selected in having the characteristic shape out of many lines sent up from the principal fishing districts of Japan. The lines for these boats are shown in Fig. 1. (I—VIII), their principal dimensions and particulars being given in Table 1. The

Table 1.

Principal Dimensions and Particulars of Actual Ships.

Notation of Ship.	Name of Ship.	Principal Dimension.			Gross Tonnage.	B. H. P. of Engine.	Speed.	Draft.	
I	Takoshima Maru.	18.20 m	3.48 m	1.37 m	17.5	35.0	8	Bow Stern	0.97m 1.52m
II	Dendo Maru.	17.00 m	3.52 m	1.61 m	19.0	30.0	8	B. S.	0.61m 1.46m
III	Niikata Maru.	50 3 f in	12 1 f in	4 10 f in	18.0	30.0	8	B. S.	1f 9in 4f 3in
IV	Fukuwaka Maru.	67 0 f in	16 0 f in	6 8 f in	47.0	80.0	8	B. S.	3f 6in 5f 0in
V	Genei Maru.	18.20 m	3.64 m	1.97 m	19.0	50.0	8.5	B. S.	0.67m 1.39m
VI	Kumano Maru.	55 6 f in	12 6 f in	6 0 f in	25.0	50.0	7.5	B. S.	2f 0in 5f 7in
VII	Matsuura Maru.	80 0 f in	14 0 f in	8 0 f in	53.8	80.0	8	B. S.	5f 3in 8f 5in
VIII	Riusho Maru.	73 0 f in	14 0 f in	7 6 f in	49.4	75.0	7.5	B. S.	4f 6in 7f 8in

models used were made of wood, cut from one block each and made similar to the lines shown in Fig. 1. The length of each model was equally five feet between the perpendiculars. The experimental apparatus was a temporary one and was the same with that used in the former experiments.

The experimental conditions are arranged in Table 2, which gives mean drafts, displacements and wetted surfaces of models with the corresponding values for actual ships put in for comparison. The draft conditions marked with an * in Table 2 correspond to those for the draft in Table 1, and the draft fore

Table 2.

Draft, Displacement and Wetted Surface.

Notation of Ships.	Condition.	Draft of Models.			Draft of Actual Ships.			Displacement of Models.	Displacement of Actual Ships.	Wetted Surface Area of Models.	Wetted Surface Area of Actual Ships.
		Mean.	Bow.	Stern.	Mean.	Bow.	Stern.				
		cm	cm	cm				K.G.	Ton	cm^2	$□'$
I	A	9.17	7.63	12.70	3′ 7″.5	2′11″.8	5′9″.6	11.39	19.06	4323	662.0
	* B	10.17			3′ 11″.8			14.24	23.83	4681	717.0
	C	11.17			4′ 4″.3			17.23	28.85	5046	772.5
II	A	8.24	5.44	13.03	3′ 1″.2	1′11″.9	4′9″.2	16.56	22.65	4557	611.0
	* B	9.24			3′ 4″.6			19.55	26.73	4919	658.5
	C	10.24			3′ 9″			23.08	31.57	5190	695.0
III	A	—	—	—	——	——	——	—	—	—	—
	* B	9.09	5.28	12.90	3′ 0″	1′9″	4′3″	16.90	16.88	4850	527.5
	C	10.09			3′ 4″			20.60	20.58	5293	576.5
IV	A	8.56	7.95	11.37	3′ 9″.2	3′6″	5′0″	18.74	44.45	5223	1011.0
	* B	9.66			4′ 3″.0			23.09	54.74	5695	1102.0
	C	10.56			4′ 7″.8			27.04	64.14	6098	1180.0
V	A	7.32	5.02	11.60	2′ 11″.2	2′0″	4′7″	18.09	30.27	4831	739.0
	* B	8.32			3′ 3″.6			21.59	36.11	5122	784.0
	C	9.32			3′ 7″.8			25.29	42.31	5475	837.0
VI	A	9.42	5.49	15.34	3′ 5″.1	2′0″	5′7″	22.10	29.48	5502	730.0
	* B	10.42			3′ 9″.5			26.00	34.70	5866	778.0
	C	11.42			4′ 1″.4			30.25	40.35	6210	823.8
VII	A	11.02	10.01	16.03	5′ 8″.7	5′3″	8′5″	23.42	94.55	5220	1440.0
	B	12.02			6′ 3″.7			26.62	107.50	5523	1523.0
	* C	13.02			6′ 10″.0			30.10	121.50	5843	1610.0
VIII	A	11.69	9.39	16.00	5′ 7″.2	4′6″	7′8″	28.43	87.04	5859	1345.0
	* B	12.69			6′ 1″.2			32.43	99.26	6202	1423.0
	C	—			——			—	—	—	—

and aft are given for that condition only. Generally, three different drafts with parallel water planes 1 cm apart were selected ; but in the case of vessels III and VIII, only two drafts were taken.

Results of the experiments.

The experimental results are given in Table 3 in which S_A, S_B, S_C are the speeds at 3 different drafts, and R_A, R_B, R_C are the resistances corresponding to S_A, S_B, S_C.

Fig 2. illustrates the results given in Table 3. From these experimental curves in Fig. 2, many values concerning the resistance were calculated, and are put in Table 4, whose notations are as follows.

V_m Speed of models in knots.

R_t Total resistance of models in grams.

$\frac{R_t}{\Delta^{K.G.}}$ Ratio of the total resistance of models in grams to the displacement of models in kilograms.

R_f Frictional resistance of models in grams.

R_r Residuary resistance of models in grams.

$\frac{R_r}{\Delta^{K.G.}}$ Ratio of the residuary resistance of models in grams to the displacement of models in kilograms.

R_R Residuary resistance of actual ships in pounds.

R_R Residuary resistance of actual ships in pounds.

R_F Frictional resistance of actual ships in pounds.

R_T Total resistance of actual ships in pounds.

$E.H.P.$ Effective horse power of actual ships.

$\frac{E.H.P.}{\Delta^T}$ Ratio of effective horse power of acual ships to the displacement of actual ships in tons.

C Ratio of $\frac{E.H.P.}{\Delta^T}$ for consecutive experimental drafts.

V_S Speed of actual ships in knots.

$\frac{V}{\sqrt{L}}$ Speed length ratio, V in knots and L in feet.

From this table, the curves of R_t R_f R_r $E.H.P.$ and $\frac{E.H.P.}{\Delta^T}$ are plotted as shown in Figures 3, 4, 5, 6 and 7.

Some comments are needed for the above mentioned results. The most remarkable point of the results is that, the vessels V—VIII show abnormal increase of resistance for speed increase in the experimental range of speed, whereas I—IV show no such tendency for the same. According to the theory of Baker and others the abnormal increase of resistance may be expected for any vessel. The fact that models I—IV show no such property may be probably due to the less interference effect between diverging waves and waves due to the pressure distribution, namely, because of the fine shape of these types.

Concerning the abnormal increase of resistance for the models V—VIII, some investigations on the lines were performed. Variation of sectional area (1), variation of girth (2), and variation of breadth of water plance (3) each along the length of ship are shown in Figs 8, 9 and 10. Those types which show the abnormal increase of resistance appear to have larger values of sectional area, girth, and breadth of water plane, in their aft body, and it is especially the case with the vessel V. The effect of knuckle or chine line also can not escape our attention. The vessels V—VIII have the angular edges at their bilges, especially in the vessel V; the side and bottom are composed of practically

straight lines, making distinctive angular bilge. The vessels I—IV, on the contrary, have no angular edge and show no abnormal increase of resistance.

Attention was also paid to the relation between displacement and resistance. Generally, the total resistance of those ships which have large displacement, is large in value, although ratio of resistance to displacement somewhat decreases as the size of the ships increases. As regards abrormal increase of resistance, however, the projected area of wetted portion on the plane perpendicular to the direction of motion seems to be more responsible than the displacement. The ships which have the larger projected area have the larger resistance and also have the tendency to show abnormal increase of resistance (Table 5.).

Table 5.

Projected Area of Wetted Portion of Ship to the Plane Perpendicular to the Direction of Motion.

Notation of Ship.	Projected Area.		Comparative Order.
I	177.0 □ cm	(27.44 □ in)	1
II	244.0	(37.84)	3
III	194.6	(30.18)	2
IV	259.6	(40.26)	4
V	287.0	(44.50)	5
VI	318.7	(49.40)	7
VII	311.3	(48.28)	6
VIII	347.0	(53.80)	8

The speeds at which abnormal increase occurs were calculated by Baker's formula for critical speed, and it is known that those actual speeds of V—VIII from experiments are not far from the calculated value taking $n=1$. Calculated values by McAlister's formula taking $n=1\frac{1}{2}$ are almost equal to those by Baker's formula, taking $n=1$ (Table 6.).

As one of the ways of examining ship forms, $\frac{R_t}{\Delta^{K.G.}}$ at equal draft was calculated and plotted in the diagram. (Fig. 11. A and B). Referring to the curves obtained, the vessels VII, IV seem to be economical at enumerated speed for the draft considered. For the vessel V, though the value of $\frac{R_t}{\Delta^{K.G.}}$ is small at

Table 6.

Critical Speed.

Notation of Ship.	Critical Speed from Baker's Formula ($n=1$).	Critical Speed from McAlister's Formula ($n=1\frac{1}{2}$).
I	$2.28\sqrt{K}$	$2.25\sqrt{K}$
II	2.34	2.32
III	2.26	2.30
IV	2.36	2.32
V	2.42	2.38
VI	2.38	2.37
VII	2.48	2.37
VIII	2.46	2.36

ow speed, it becomes great at high speed, so the shape is probably not economical for high speed. It must be noticed, of course, that the ship which has arger displacement has the smaller value of $\frac{R_t}{\Delta^{K.G.}}$, and the draft therefore may ave the great effect on the value of $\frac{R_t}{\Delta^{K.G.}}$, even with the same ship.

We can say generally that the types I—IV (so called European type) are ore economical for high speed, and types V—VIII (so called Japanese type nd mixed type) are more economical for low speed.

The reason why our fishing circle sticks to the ship forms up to now may e that, the forms are selected in consideration of rolling rather than power conomy. Really, most of our fishing vessels have had no engine and been used t such low speed by rowing or by sailing.

It may be interesting to remark here that the illustration of Scott Russell the resistance of ships which have small entrance and run, increases greatly ith the speed" is shown also in our experiments. It is clear when we inspect ne lines of vessels (Fig. 1.) and the resistance curves (Fig. 2.).

As to the powers required to propel the ships, though *B. H. P.* in Table 1. not reliable, it must be interesting to make rough comparison between the alculated values of *B. H. P.* and the values of *B. H. P.* in Table 1, assuming propulsive efficiency $\left(\frac{E.H.P.}{B.H.P.}\right)$ to be 0.5. The following table (Table 7.) given for such a comparison.

Table 7.

E. H. P. and Speed.

Notation of Ship.	Speed expected.	*E. H. P.* calculated.	*E. H. P.* of Engine set in Ship.	Speed calculated.
I	8.0^{K}	34 $^{H.P.}$	35 $^{H.P.}$	8.1^{K}
II	8.0	38	30	7.5
III	7.5	50	50	7.5
IV	8.0	56	80	8.8
V	8.5	88	50	7.4
VI	7.5	70	75	7.6
VII	8.0	90	80	7.8
VIII	8.0	33	30	7.8

Summary.

The resistance of Teguriami fishing vessels are measured. (1) As the types are extremely different, the resistance are greatly different with the ship, for instance the value of $\frac{E.H.P.}{\Delta^{T}}$ at speed 8 knots, the greatest one is about 2.7 times that of the smallest (Fig. 7.). (2) The abnormal increase of resistance, appears distinctly in the so called Japanese type or mixed type, which has the angular shape. The so called European type which is of ordinary shape, have no abnormal increase of resistance in the experimental range. (3) At low speed, the angular shaped types have not always great resistance, and for speeds lower than 6 knots, $\frac{E.H.P.}{\Delta^{T}}$ is rather less than those of ordinary types. As for the fishing vessels in which rolling must be specially considered, the Japanese types can not simply be said to be the bad shape, but we can say that for the high speed vessel, these will not be the favourable forms.

In conclusion the authers wish to express their indebtedness to Professor Dr. T. Yamamoto for his valuable advices, and to Professor I. Gensho for his painstaking works of constructing the experimental apparatus jointly with Prof. T. Yamamoto, and also to our assistant, Mr. S. Muto, for his tedious calculation.

(A) draft.		* (B) draft.		(C) draft.	
Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.
0.993 k. (0.511 m/s.)	25.1 gr.	1.160 (0.597)	46.8 gr.	1.087 (0.559)	46.4 gr.
1.119 (0.576)	34.0	1.238 (0.637)	56.4	1.208 (0.622)	60.0
1.237 (0.637)	48.6	1.558 (0.802)	87.5	1.450 (0.746)	86.5
1.337 (0.688)	55.2	1.652 (0.850)	105.0	1.624 (0.835)	108.4
1.390 (0.715)	61.0	1.805 (0.929)	122.9	1.852 (0.953)	145.5
1.548 (0.796)	78.3	1.912 (0.984)	141.7	1.987 (1.021)	167.4
1.713 (0.881)	98.2	2.026 (1.040)	163.3	2.100 (1.078)	192.9
1.722 (0.886)	102.2	2.130 (1.094)	183.2	2.210 (1.136)	224.0
1.873 (0.963)	122.1	2.262 (1.162)	214.0	2.360 (1.212)	259.3
2.012 (1.033)	143.1	2.288 (1.176)	214.0	2.500 (1.285)	301.2
2.130 (1.095)	167.6	2.400 (1.233)	244.0	2.605 (1.338)	337.8
2.267 (1.166)	194.0	2.417 (1.243)	249.4	2.665 (1.370)	362.0
2.386 (1.227)	218.8	2.548 (1.310)	285.4		
2.528 (1.300)	254.0	2.583 (1.327)	303.4		
2.582 (1.327)	275.0	2.720 (1.399)	351.9		

II

(A) draft.		* (B) draft.		(C) draft.	
Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.
0.680 k. (0.350 m/s.)	14.7 gr.	0.793 (0.408)	27.9 gr.	1.117 (0.574)	62.3 gr.
0.879 (0.452)	30.3	0.912 (0.469)	38.4	1.215 (0.625)	74.0
1.032 (0.531)	45.8	1.064 (0.548)	52.5	1.400 (0.720)	97.5
1.217 (0.626)	64.2	1.234 (0.635)	71.2	1.453 (0.748)	106.1
1.374 (0.707)	83.7	1.428 (0.734)	98.0	1.580 (0.813)	123.9
1.527 (0.786)	104.2	1.524 (0.784)	114.0	1.673 (0.860)	146.2
1.669 (0.859)	126.2	1.685 (0.866)	136.8	1.775 (0.913)	164.5
1.820 (0.936)	145.6	1.805 (0.928)	154.0	1.853 (0.953)	181.9
1.930 (0.994)	160.2	1.857 (0.955)	167.6	1.927 (0.991)	197.0
2.020 (1.040)	180.0	1.872 (0.963)	166.8	2.050 (1.055)	222.5
2.112 (1.087)	199.8	1.937 (0.996)	182.1	2.153 (1.108)	252.5
2.185 (1.124)	217.5	1.939 (0.997)	175.0	2.277 (1.171)	286.7
2.280 (1.173)	235.2	2.993 (1.025)	190.2	2.397 (1.233)	324.0
2.383 (1.226)	263.3	2.097 (1.078)	213.0	2.490 (1.281)	358.7
2.477 (1.275)	289.0	2.430 (1.250)	307.7	2.595 (1.335)	401.9
2.485 (1.279)	299.3			2.603 (1.340)	404.8

III

* (B) draft.		(C) draft.	
Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.
1.093 k. (0.562 m/s.)	53.7 gr.	1.273 (0.655)	79.2 gr.
1.196 (0.615)	64.3	1.403 (0.721)	97.3
1.377 (0.708)	90.8	1.533 (0.788)	116.3
1.512 (0.777)	105.3	1.702 (0.876)	145.8
1.667 (0.858)	130.1	1.733 (0.891)	153.5
1.713 (0.881)	137.4	1.843 (0.948)	174.0
1.785 (0.919)	153.1	1.937 (0.998)	188.4
1.910 (0.982)	173.5	2.082 (1.070)	222 8
2.042 (1.050)	202.7	2.185 (1.122)	251.5
2.173 (1.116)	231.2	2.330 (1.197)	303.1
2.320 (1.192)	274.0	2.445 (1.261)	355.0
2.464 (1.266)	315.0	2.600 (1.336)	423.2
2.595 (1.333)	359.2	2.725 (1.400)	497.8

IV

(A) draft.		* (B) draft.		(C) draft.	
Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.
0.937 k. (0.484 m/s.)	36.2 gr.	0.968 (0.498)	41.7 gr.	0.994 (0.511)	50.9 gr.
1.140 (0.587)	57.7	1.097 (0.564)	56.8	1.175 (0.604)	69 6
1.265 (0·651)	66.6	1.231 (0.634)	73.6	1.350 (0.694)	97.6
1.408 (0.724)	84.0	1.402 (0.721)	97.4	1.443 (0.742)	112.8
1.553 (0.798)	107.2	1.523 (0.783)	115.0	1.568 (0.806)	139.8
1.690 (0.870)	128.8	1.667 (0.858)	140.5	1.717 (0.883)	162.2
1.840 (0.947)	151.0	1.800 (0.926)	168.9	1.838 (0.945)	190.3
1.987 (1.022)	182.0	1.965 (1.010)	204.0	2.006 (1.032)	228.7
2.098 (1.079)	205.7	2.040 (1.049)	213.8	2.135 (1.097)	270.0
2.234 (1.149)	239.5	2.182 (1.122)	260.1	2.255 (1.160)	318.6
2.412 (1.240)	304.8	2.340 (1.203)	316.7	2.385 (1.226)	388.7
2.527 (1.300)	344.0	2.355 (1.210)	323.4	2.540 (1.306)	448.7
2.632 (1.353)	377.0	2.477 (1.274)	374.8	2.552 (1.313)	467.3
		2.506 (1.288)	372.6		

(A) draft.		* (B) draft.		(C) draft.	
Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.
1.178 k. (9,606 m/s.)	71,2 gr.	1.002 (0.515)	48.4 gr.	1.092 (0.562)	70.5 gr.
1.313 (0.675)	87.7	1.132 (0.582)	67.5	1.183 (0.608)	81.3
1.437 (0.739)	110.9	1.254 (0.645)	86.2	1.308 (0.673)	100.5
1.539 (0.791)	123.6	1.373 (0.706)	102.9	1.465 (0.754)	129.0
1.680 (0.864)	149.3	1.562 (0.803)	133.5	1.588 (0.817)	147.9
1.784 (0.917)	167.1	1.657 (0.852)	153.3	1.678 (0.863)	169.9
1.894 (0.974)	192.0	1.795 (0.923)	176.8	1.796 (0.924)	195.6
2.043 (1.050)	247.3	1.904 (0.979)	208.7	1.928 (0.992)	240.7
2.183 (1.123)	318.3	2.040 (1.050)	266.2	2.056 (1.057)	294.8
2.183 (1.123)	331.5	2.112 (1.117)	343.8	2.156 (1.109)	356.0
2.296 (1.180)	372.1	2.275 (1.170)	408.9	2.275 (1.170)	437.9
2.385 (1.226)	410.4	2.385 (1.226)	456.7	2.404 (1.237)	500.4
2.405 (1.237)	428.4	2.500 (1.285)	508.0	2.500 (1.286)	552.5
2.507 (1.290)	459.8	2.583 (1.328)	547.5		
2.567 (1.320)	491.8				
2.650 (1.363)	537.3				

VI

(A) draft.		* (B) draft.		(C) draft.	
Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Besistance.	Speed knot. (m/sec.).	Resistance.
1.077 k. (0.554 m/s.)	64.0 gr.	1.015 (0.522)	62.8 gr.	1.061 (0.546)	77.1 gr.
1.222 (0.629)	82.5	1.166 (0.600)	81.6	1·207 (0.621)	101·2
1.222 (0.629)	82.7	1.290 (0.664)	104.3	1.326 (0.682)	122.0
1.327 (0.682)	106.2	1.408 (0.724)	126.0	1.436 (0.738)	144.1
1.509 (0.776)	139.2	1.554 (0.800)	152.9	1.547 (0.795)	166.2
1.600 (0.823)	152.7	1.688 (0.869)	182.6	1.717 (0.884)	206.2
1.770 (0.910)	198.9	1.827 (0.940)	216.7	1.785 (0.918)	225.3
1.908 (0.982)	234.0	1.962 (1.008)	266.7	1.928 (0.992)	271.9
2.036 (1.047)	274.0	2.127 (1.092)	321.3	2.085 (1.070)	327.9
2.170 (1.116)	319.3	2·185 (1.122)	366.8	2.143 (1.101)	384.6
2.262 (1.163)	357.8	2.267 (1.163)	412.0	2.250 (1.156)	456.5
2.424 (1.246)	424.0	2.333 (1.199)	442.2	2.365 (1.215)	517.9
2.495 (1.283)	448.4	2.373 (1.220)	456.1	2.484 (1.277)	578.6

VII

(A) draft.		(B) draft.		*(C) draft.	
Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.
0.923 k. (0.474 m/s.)	34.0 gr.	1.083 (0.557)	51.1 gr.	0.998 (0.513)	47.0 gr.
0.953 (0.490)	35.4	1.173 (0.603)	62.9	1.150 (0.592)	60.9
1.052 (0.541)	45.1	1.266 (0.651)	73.2	1.247 (0.642)	74.0
1.217 (0.626)	60.0	1.430 (0.735)	95.3	1.367 (3.703)	91.8
1.357 (0.698)	76.9	1.516 (0.780)	104.5	1.512 (0.777)	110.5
1.503 (0.773)	96.9	1.673 (0.860)	135.6	1.733 (0.891)	159.5
1.622 (0.834)	114.0	1.785 (0.918)	164.7	1.870 (0.962)	194.0
1.806 (0.929)	149.4	1.905 (0.981)	191.0	1.970 (1.012)	219.5
1.900 (0.978)	174.0	1.983 (1.020)	216.3	2.080 (1.068)	280.0
2.043 (1.050)	219.8	2.017 (1.037)	230.0	2.170 (1.115)	355.0
2.198 (1.130)	289.6	2.047 (1.052)	238.5	2.265 (1.163)	441.0
		2.180 (1.120)	327.6	2.345 (1.205)	350.3
		2.350 (1.208)	428.5	2.390 (1.228)	585.6
		2.477 (1.272)	569.3		

VIII

(A) draft.		*(B) draft.	
Speed knot. (m/sec.).	Resistance.	Speed knot. (m/sec.).	Resistance.
1.103 k. (0.567 m/s.)	63.1 gr.	1.140 (0.587)	71.6 gr.
1.350 (0.694)	96.5	1.423 (0.731)	121.4
1.480 (0.761)	121.7	1.598 (0.822)	156.7
1.650 (0.849)	159.3	1.696 (0.872)	184.0
1.785 (0.918)	189.9	1.830 (0.942)	220.9
1.866 (0.961)	218.1	1.942 (0.999)	257.3
2.017 (1.037)	265.6	2.114 (1.087)	334.0
2.182 (1.120)	339.2	2.214 (1.137)	388.0
2.285 (1.173)	404.9	2.302 (1.183)	461.0
2.428 (1.248)	475.0	2.451 (1.260)	557.0
2.555 (1.313)	538.3	2.583 (1.327)	624.0

Table 4.

Numerical Values Calculated from Fig. 2.

I

V_m.	R_t.	$\frac{R_t}{\Delta^{K.G.}}$.	R_f.	R_r.	$\frac{R_r}{\Delta^{K.G.}}$.	R_R.	R_F.	R_T.	C.	$\frac{E.H.P.}{\Delta^T}$.	$E.H.P.$	$\frac{V_S}{(\frac{V_S}{\sqrt{L}})}$.
	26.4	2.32	22.6	3.8	0.33	14.59	61.8	76.4	1.017	0.043	0.82	
.014	31.6	2.22	24.6	7.0	.49	26.87	66.9	93.8	1.006	0.042	1.01	3.5
	37.0	2.15	26.4	10.5	.62	40.70	72.2	112.9		0.042	1.21	0.453
	39.0	3.43	29.4	9.6	.84	36.87	77.1	114.0	1.060	0.074	1.42	
.159	45.6	3.20	32.0	13.6	.96	52.22	83.6	135.8	1.013	0.070	1.67	4.0
	53.6	3.11	34.8	18.8	1.09	72.20	90.1	162.3		0.069	1.99	0.518
	52.0	4.57	37.2	14.8	1.30	56.80	97.1	153.9	1.057	0.112	2.13	
.303	60.0	4.22	40.0	20.0	1.40	76.80	105.2	182.0	1.060	0.106	2.52	4.5
	68.2	3.96	43.5	24.7	1.43	94.80	113.4	208.2		0.100	2.88	0.582
	67.8	5.06	46.0	21.8	1.91	83.70	118.3	202.0	1.099	0.163	3.10	
.449	76.0	5.34	49.4	26.6	1.87	102.2	128.1	230.3	1.058	0.148	3.54	5.0
	86.0	5.00	53.3	32.7	1.90	125.6	138.0	263.6		0.140	4.05	0.647
	84.6	7.44	54.8	29.8	2.62	114.5	140.7	255.2	1.133	0.226	4.31	
.593	93.2	6.55	59.6	33.6	2.36	129.0	152.4	281.4	1.089	0.200	4.75	5.5
	103.0	5.98	64.2	33.8	2.25	149.0	164.2	313.2		0.183	5.29	0.712
	104.0	9.14	65.0	39.0	3.43	149.8	165.0	314.8	1.129	0.304	5.80	
.740	114.8	8.06	70.6	44.2	3.10	169.7	187.7	348.4	1.113	0.269	6.42	6.0
	124.6	7.23	76.0	48.6	2.82	186.6	192.6	379.2		0.242	6.98	0.777
	124.7	10.96	76.0	48.7	4.28	187.0	190.2	377.2	1.135	0.395	7.53	
.884	137.0	9.62	82.7	54.7	3.84	210.0	206.0	416.0	1.095	0.348	8.30	6.5
	151.0	8.76	88.8	62.2	3.61	238.8	222.0	460.8		0.318	9.19	0.842
	147.4	12.96	87.6	59.8	5.25	229.7	218.3	448.0	1.133	0.505	9.63	
2.027	161.8	11.37	94.8	67.0	4.71	257.3	236.4	493.7	1.095	0.445	10.61	7.0
	178.0	10.33	102.0	76.0	4.41	291.8	255.0	546.8		0.407	11.75	0.906
	175.0	15.38	99.8	75.2	6.60	288.7	248.8	537.5	1.143	0.649	12.37	
2.171	191.2	13.43	108.2	83.0	5.83	318.7	269.5	588.2	1.096	0.569	13.54	7.5
	210.4	12.23	116.7	93.7	5.44	359.8	290.6	650.4		0.519	14.98	0.971
	203.8	17.90	113.0	90.8	7.97	348.6	278.7	627.3	1.141	0.810	15.42	
2.316	223.4	15.68	122.6	100.8	7.08	387.0	301.8	688.8	1.083	0.710	16.92	8.0
	248.0	14.40	132.2	115.8	6.72	444.7	325.4	770.1		0.656	18.92	1.035
	237.0	20.83	127.0	110.0	9.67	422.3	311.6	733.9	1.129	1.005	19.15	
2.460	261.0	18.33	137.4	123.6	8.67	474.7	337.5	812.2	1.090	0.890	21.20	8.5
	289.0	16.78	148.6	140.4	8.15	539.0	363.7	902.7		0.817	23.56	1.100
	280.0	24.62	142.6	137.4	12.07	527.8	345.7	873.5	1.105	1.266	24.13	
2.607	309.0	21.70	154.2	154.8	10.87	594.4	374.5	968.9	1.123	1.123	26.77	9.0
	338.4	19.65	166.2	172.2	9.99	661.0	403.5	1064.5		1.020	29.40	1.165

V_m.	R_t.	$\frac{R_t}{\Delta^{K.G.}}$.	R_j.	R_r.	$\frac{R_r}{\Delta^{K.G.}}$.	R_R.	R_F.	R_T.	C.	$\frac{E.H.P.}{\Delta^T}$.	$E.H.P.$	$\frac{V_S}{\sqrt{L}}$
	32.4	2.02	19.0	13.4	0.81	42.1	43.2	85.3	1.152	0.035	0.78	3.0
0.898	36.6	1.87	20.4	16.2	.83	50.9	46.6	87.4		0.030	0.81	0.402
	—	—	—	—	—	—	—	—		—	—	
	47.2	2.85	26.1	21.0	1.27	65.9	57.3	123.3	1.074	0.059	1.33	3.5
1.048	51.2	2.62	27.7	23.5	1.20	73.8	61.9	135.7	1.105	0.055	1.46	0.469
	54.3	2.35	29.0	25.3	1.10	79.4	65.3	144.7		0.049	1.56	
	62.0	3.75	33.4	28.6	1.73	89.8	71.5	161.3	1.085	0.088	1.98	4.0
1.197	66.8	3.42	35.4	31.4	1.61	98.6	77.2	175.8	1.118	0.081	2.16	0.537
	70.8	3.06	37.7	33.1	1.43	103.9	81.5	185.4		0.072	2.28	
	79.4	4.80	42.0	37.4	2.26	117.4	90.1	207.5	1.090	0.127	2.87	4.5
1.348	85.2	6.36	44.8	40.4	2.07	126.9	97.3	224.2	1.110	0.116	3.10	0.6036
	90.6	3.92	47.4	43.2	1.87	135.7	102.6	238.3		0.104	3.29	
	98.2	5.94	51.0	47.2	2.85	148.2	109.7	257.9	1.093	0.175	3.96	5.0
1.497	106.0	5.42	54.8	51.2	2.62	160.8	118 4	279.2	1.117	0.160	4.29	0.670
	112.5	4.87	58.6	53.9	2.34	169.3	124.9	294.2		0.143	4.52	
	119.2	7.20	61.6	57.6	3.48	180.7	130.5	311.2	1.087	0.232	5.25	5.5
1.647	129.2	6.60	66.2	63.0	3.22	197.9	140.8	338.7	1.100	0.214	5.72	0.737
	139.0	6.02	70.6	68.4	2.96	214.8	148.6	363.4		0.194	6.13	
	141.8	8.56	72.8	69.0	4.17	216.5	153.0	369.5	1.081	0.301	6.80	6.0
1.797	154.8	7.92	78.6	76.2	3.90	239.3	165.2	404.5	1.078	0.279	7.45	0.804
	169.0	7.31	83.4	85.6	3.71	268.7	174.2	442.9		0.258	8.15	
	166.4	10.06	84.7	81.7	4.94	256.6	176.4	433.0	1.085	0.382	8.64	6.5
1.946	180.8	9.24	91.4	89.4	4.58	280.7	190.4	471.1	1.057	0.351	9.40	0.871
	200.2	8.66	96.7	103.5	4.48	325.2	200.8	526.0		0.333	10.50	
	196.4	11.87	98.0	98.4	5.95	309.2	202.6	511.8	1.083	0.487	11.00	7.0
2.098	214.4	10.97	106.4	108.0	5.53	339.3	218.7	558.0	1.053	0.449	11.99	0.938
	236.8	10.25	111.4	125.4	5.44	394.0	230.7	624.7		0.426	13.42	
	229.2	13.85	111.6	117.6	7.10	369.3	230.8	600.1	1.083	0.611	13.82	7.5
2.246	250.6	12.80	121 4	129.2	6 61	406.0	249.0	655.0	1.057	0.564	15.07	1.006
	276.0	11.94	127.2	148.8	6.44	467.4	262.7	730.1		0.534	16.82	
	267.0	16.13	127.4	138.6	8.37	435.3	258.6	693.9	1.070	0.752	17.03	8.0
2.395	293.0	14.98	137.6	155.4	7.95	488.0	279.1	767.1	1.063	0.704	18.82	1.072
	322.0	13.93	144.6	177.4	7.69	557.0	294.3	851.3		0.664	20.90	
	314.0	19.00	144.6	170.0	10.27	534.0	288.0	822.0	1.073	0.948	21.43	8.5
2.546	344.0	17.69	154.6	189.4	9.69	594.7	311.9	906.6	1.057	0.884	23.65	1.140
	380.0	16.43	162.8	217.2	9.40	682.0	329.0	1011.0		0.836	26.37	

V_m.	R_t.	$\frac{R_t}{\Delta^{K.G.}}$.	R_f.	R_r.	$\frac{R_r}{\Delta^{K.G.}}$.	R_R.	R_P.	R_T.	C.	$\frac{E.H.P.}{\Delta^T}$.	$E.H.P.$	V_S. $(\frac{V_S}{\sqrt{L}})$.
104	—	—	—	—	—	—	—	—	1.202	—	—	3.5
	58.4	3.46	31.4	27.1	1.60	62.3	49.9	112.2		0.075	1.26	0.494
	62.6	3.04	34.6	28.0	1.36	64.4	54.4	118.8		0.062	1.28	
263	—	—	—	—	—	—	—	—	1.160	—	—	4.0
	73.0	4.32	38.5	34.5	2.04	79.4	62.3	141.7		0.103	1.74	0.564
	77.6	3.77	42.3	35.3	1.72	81.1	68.0	149.1		0.089	1.83	
420	—	—	—	—	—	—	—	—	1.163	—	—	4.5
	93.6	5.54	48.3	45.3	2.68	104.2	78.4	182.6		0.150	2.52	0.635
	98.8	4.80	52.8	46.0	2.24	105.3	85.6	191.4		0.129	2.65	
580	—	—	—	—	—	—	—	—	1.161	—	—	5.0
	117.0	6.92	59.8	57.2	3.33	131.5	95.4	226.9		0.207	3.48	0.705
	124.0	6.02	65.6	58.4	2.84	134.3	104.1	238.4		0.178	3.66	
736	—	—	—	—	—	—	—	—	1.146	—	—	5.5
	142.8	8.45	72.0	70.8	4.19	162.7	113.6	276.2		0.274	4.66	0.776
	152.0	7.38	79.0	73.0	3.55	167.8	123.9	291.7		0.240	4.92	
893	—	—	—	—	—	—	—	—	1.143	—	—	6.0
	171.0	10.12	85.0	86.0	5.09	197.6	133.2	330.8		0.360	6.09	0.846
	183.6	8.90	93.4	90.2	4.39	207.3	145.2	352.5		0.316	6.49	
050	—	—	—	—	—	—	—	—	1.141	—	—	6.5
	203.0	12.00	100.0	103.0	6.10	236.8	153.5	390.3		0.462	7.79	0.917
	218.8	10.62	109.0	109.8	5.34	252.3	167.5	419.8		0.405	8.33	
210	—	—	—	—	—	—	—	—	1.110	—	—	7.0
	242.0	14.32	116.0	126.0	7.46	289.6	176.3	465.9		0.593	10.01	0.9865
	262.8	12.75	126.4	136.4	6.63	313.5	192.4	505.9		0.534	10.99	
368	—	—	—	—	—	—	—	—	1.098	—	—	7.5
	288.0	17.05	132.8	155.2	9.19	356.7	200.8	557.5		0.761	12.84	1.058
	318.4	15.45	144.6	173.8	8.45	399.5	219.2	618.7		0.693	14.25	
522	—	—	—	—	—	—	—	—	1.075	—	—	8.0
	342.4	20.28	150.0	192.4	11.40	442.2	225.0	667.2		0.970	16.38	1.128
	385.4	18.70	163.8	221.6	10.77	509.3	245.4	754.7		0.902	18.55	
684	—	—	—	—	—	—	—	—	1.050	—	—	8.5
	411.0	24.32	169.0	242.0	14.32	556.0	251.4	807.4		1.247	21.06	1.128
	472.4	22.62	184.7	287.7	13.97	661.3	274.3	935.6		1.187	24.40	

V_m.	R_t.	$\frac{R_t}{\Delta^{K.G.}}$.	R_f.	R_r.	$\frac{R_r}{\Delta^{K.G.}}$.	R_R.	R_F.	R_T.	C.	$\frac{E.H.P.}{\Delta^T}$.	$E.H.P.$	V_m $(\frac{V_m}{\sqrt{L}})$
	50.4	2.69	31.6	18.8	1.003	102.4	117.1	219.5	1.085	0.061	2.70	
1.093	56.0	2.43	34.6	21.4	0.927	016.5	127.6	244.1	1.067	0.056	3.06	4.0
	62.0	2.29	36.8	25.2	0.932	037.3	136.6	273.9		0.052	3.36	0.48
	64.5	3.44	40.0	24.5	1.307	133.5	147.5	281.0	1.080	0.087	3.88	
1.229	71.6	3.10	43.4	28.2	1.222	153.6	167.5	321.1	1.050	0.081	4.44	4.5
	80.5	2.98	46.4	34.1	1.262	185.7	172.0	357.7		0.077	4.94	0.54
	80.8	4.32	49.4	31.4	1.677	171.0	179.5	350.5	1.099	0.121	5.38	
1.366	89.8	3.89	53.4	36.4	1.576	198.2	195.5	393.7	1.033	0.110	6.04	5.0
	100.7	3.72	57.3	43.4	1.605	236.3	209.2	445.5		0.107	6.83	0.61
	99.0	5.29	59.2	39.8	2.124	216.7	313.7	430.4	1.093	0.163	7.26	
1.503	110.7	4.80	64.4	46.3	2.006	252.0	232.8	484.8	1.035	0.150	8.19	5.5
	124.0	4.59	69.2	54.8	2.027	299.5	249.0	548.5		0.145	9.26	0.67
	119.8	6.39	69.8	50.0	2.670	274.0	250.3	524.3	1.098	0.217	9.65	
1.639	134.0	5.80	76.0	58.0	2.513	315.7	272.8	588.5	1.030	0.198	10.82	6.0
	150.6	5.57	81.4	69.2	2.560	376.6	292.0	668.6		0.192	12.30	0.73
	143.0	7.63	81.4	61.6	3.286	335.2	288.8	624.0	1.099	0.280	12.44	
1.775	160.0	6.93	89.2	70.8	3.064	385.7	314.7	700.4	1.038	0.255	13.97	6.5
	178.8	6.61	95.4	83.4	3.082	453.8	336.7	790.5		0.246	15.77	0.79
	168.0	8.96	94.2	73.8	3.940	401.6	331.6	733.2	1.093	0.354	15.75	
1.912	188.0	8.15	102.7	85.3	3.694	464.7	361.3	826.0	1.038	0.324	17.75	7.0
	210.4	7.78	110.3	100.1	3.704	545.0	386.7	931.7		0.312	20.00	0.85
	196.0	10.45	108.0	88.0	4.700	479.0	377.7	856.7	1.094	0.444	19.71	
2.025	220.0	9.53	118.0	102.0	4.415	556.0	411.6	967.6	1.026	0.406	22.26	7.5
	248.0	5.12	126.4	121.6	4.490	662.0	440.5	1102.5		0.395	25.37	0.91
	226.0	12.05	122.3	103.7	5.535	564.6	423.0	987.6	1.070	0.545	24.25	
2.185	258.0	11.18	133.8	124.2	5.380	676.2	461.0	1137.	1.018	0.509	27.92	8.0
	292.0	10.80	143.2	148.8	5.500	810.0	493.5	1304.		0.500	32.03	0.97
	261.0	13.92	137.4	123.6	6.590	672.8	472.8	1146.	1.043	0.672	29.90	
2.320	303.4	13.14	150.2	153.2	6.630	834.2	515.3	1350.	1.001	0.643	35.22	8.5
	349.0	12.90	160.7	188.3	6.960	102.4	551.6	1576.		0.643	41.14	1.03
	309.2	16.50	154.0	155.2	6.280	844.5	524.7	1369.	1.032	0.852	37.83	
2.460	362.6	15.70	167.4	195.2	6.450	1063.	572.0	1635.	1.006	0.826	45.18	9.0
	416.0	15.37	170.4	236.6	6.750	1288.	612.0	1900.		0.820	52.53	1.10
	396.0	19.55	171.0	195.0	10.41	1061.	580.3	1641.	1.037	1.072	47.85	
2.595	428.0	18.55	186.0	242.0	10.48	1318.	632.6	1951.	1.012	1.037	56.86	9.5
	488.4	18.05	199.2	289.2	10.70	1574.	677.0	2251.		1.023	65.64	1.16

V_m.	R_t.	$\frac{R_t}{\Delta^{K.G.}}$.	R_f.	R_r.	$\frac{R_r}{\Delta^{K.G.}}$.	R_R.	R_F.	R_T.	C.	$\frac{E.H.P.}{\Delta^T}$.	$E.H.P.$	V_s. $\left(\frac{V_s}{\sqrt{L}}\right)$.
	47.0	2.60	25.4	21.6	1.20	83.0	69.0	152.0	1.070	0.054	1.63	
.016	52.0	2.41	27.0	25.0	1.16	96.1	73.2	169.3	1.057	0.050	1.82	3.5
	58.0	2.29	29.4	28.6	1.13	110.0	78.3	188.3		0.048	2.02	0.4525
	67.2	3.72	33.0	34.2	1.89	131.5	86.1	217.6	1.093	0.088	2.67	
.162	73.0	3.38	35.0	38.0	1.76	146.0	91.4	237.4	1.080	0.081	2.92	4.0
	78.7	3.11	37.8	40.9	1.62	157.2	97.7	254.9		0.075	3.13	0.5175
	87.2	4.83	41.4	45.8	2.53	176.2	108.5	284.7	1.113	0.130	3.93	
.306	93.4	4.33	44.0	49.4	2.29	190.0	115.1	305.1	1.090	0.117	4.21	4.5
	100.8	3.99	47.2	53.6	2.12	206.0	123.0	329.0		0.107	4.54	0.5825
	109.6	6.06	51.4	58.2	3.22	223.8	132.0	355.8	1.104	0.179	5.46	
.452	116.4	5.40	54.0	62.4	2.89	240.0	140.0	380.0	1.116	0.162	5.83	5.0
	124.3	4.92	57.8	66.5	2.63	255.7	149.7	405.4		0.147	6.22	0.6470
	134.0	7.42	61.4	72.6	4.02	279.2	157.2	436.4	1.138	0.243	7.37	
.597	140.6	6.52	65.0	75.6	3.50	290.7	166.6	456.9	1.090	0.214	7.71	5.5
	151.4	5.99	69.5	81.9	3.24	315.0	178.1	493.1		0.197	8.32	0.712
	158.7	8.77	72.8	85.9	4.76	330.3	184.2	514.5	1.133	0.313	9.47	
.742	167.4	7.76	77.3	90.1	4.18	346.2	195.3	541.5	1.060	0.276	9.96	6.0
	181.4	7.18	82.0	99.4	3.93	382.2	208.8	591.0		0.260	11.02	0.776
	189.2	10.47	84.8	104.4	5.78	401.5	212.3	613.8	1.107	0.404	12.24	
.887	203.4	9.43	90.2	113.2	5.25	435.3	225.2	660.5	1.052	0.365	13.18	6.5
	225.0	8.90	96.2	128.8	5.09	495.0	241.4	736.4		0.347	14.70	0.841
	243.0	13.43	97.8	145.2	8.04	558.0	243.9	801.9	1.100	0.569	17.22	
.032	262.8	12.18	103.8	159.0	7.38	611.3	258.7	870.0	1.073	0.518	18.70	7.0
	286.6	11.33	111.5	175.1	6.92	673.2	276.5	949.7		0.482	20.40	0.906
	319.4	17.67	112.0	207.4	11.49	797.3	278.0	1075.3	1.100	0.819	24.77	
.177	346.0	16.02	118.8	227.2	10.53	873.2	294.7	1167.9	1.083	0.745	26.90	7.5
	375.2	14.84	127.4	247.8	9.79	952.4	315.0	1267.4		0.689	29.17	0.971
	390.0	21.60	126.8	263.2	14.56	1012.0	311.3	1323.3	1.078	1.073	32.50	
.323	429.0	19.90	134.6	294.4	13.65	1131.0	330.3	1461.3	1.089	0.995	35.90	8.0
	461.8	18.27	144.4	317.4	12.55	1219.0	352.7	1571.7		0.913	38.61	1.036
	452.4	25.04	142.6	309.8	16.30	1191.0	348.0	1538.0	1.091	1.327	40.12	
.467	493.2	22.84	151.4	341.8	15.85	1314.0	369.0	1683.0	1.077	1.217	43.90	8.5
	536.0	21.20	162.2	373.8	14.77	1437.0	394.5	1831.5		1.130	47.80	1.100
	517.0	28.60	159.4	357.6	19.80	1374.0	386.0	1760.0	1.098	1.605	48.62	
.613	560.0	25.96	169.0	391.0	18.13	1503.0	409.5	1912.5		1.463	52.86	9.0
	—	—	—	—	—	—	—			—	—	1.164

V_m.	R_t.	$\frac{R_t}{\Delta^{K.G.}}$.	R_f.	R_v.	$\frac{R_r}{\Delta^{K.G.}}$.	R_R.	R_F.	R_T.	C.	$\frac{E.H.P.}{\Delta^T}$.	$E.H.P.$	V_s. $(\frac{1}{\sqrt{L}})$
	58.2	2.63	31.4	26.8	1.21	82.1	68.5	150.7	1.028	0.055	1.62	
1.050	65.4	2.57	32.9	32.5	1.25	99.6	73.1	172.7	1.003	0.053	1.86	3.5
	74.8	2.42	34.8	40.0	1.32	122.5	77.3	199.8		0.053	1.15	0.470
	81.2	3.67	40.5	40.7	1.84	124.7	85.5	210.2	1.067	.088	2.58	
1.200	89.0	3.42	42.9	46.1	1.77	141.3	91.1	232.3	1.036	.082	2.86	4.0
	99.0	3.27	45.4	53.6	1.77	164.2	96.5	260.7		.079	3.20	0.537
	105.8	4.79	51.0	54.8	2.48	168.0	107.3	275.3	1.086	.129	3.80	
1.350	114.0	4.39	54.0	60.0	2.31	183.7	114.9	298.6	1.045	.119	4.13	4.5
	126.0	4.17	57.2	68.8	2.28	210.7	121.5	332.2		.114	4.59	0.604
	134.8	6.10	62.1	72.7	3.29	222.7	131.0	353.7	1.102	.184	5.43	
1.500	144.0	5.54	69.2	77.8	2.99	238.3	139.7	378.0	1.092	.167	5.81	5.0
	156.0	5.16	70.2	85.8	2.84	262.8	147.9	410.7		.156	6.30	0.672
	167.8	7.59	74.6	93.2	4.22	285.5	155.9	441.4	1.113	.253	7.45	
1.650	178.6	6.86	80.0	98.6	3.79	302.0	166.3	468.3	1.097	.228	7.91	5.5
	189.2	6.26	84.7	104.5	3.46	320.3	175.9	496.2		.208	8.37	0.738
	204.0	9.23	88.2	115.8	5.24	355.0	182.8	537.8	1.132	.336	9.90	
1.800	214.0	8.23	94.7	119.3	4.59	365.5	194.9	560.4	1.088	.297	10.32	6.0
	228.0	7.54	100.0	128.0	4.24	392.2	206.3	598.5		.273	11.03	0.805
	246.0	11.13	102.8	143.2	6.48	438.7	210.8	649.5	1.127	.439	12.96	
1.950	258.8	9.95	110.3	148.5	5.72	455.0	224.7	679.7	1.089	.390	13.55	6.5
	277.8	9.18	116.7	161.1	5.34	493.7	237.7	731.4		.361	14.58	0.873
	296.0	13.40	119.0	177.0	8.02	542.4	242.0	784.4	1.110	.571	16.85	
2.100	314.0	12.08	127.0	187.0	7.20	572.8	258.1	830.9	1.056	.514	17.85	7.0
	344.0	11.38	134.7	209.3	6.92	641.4	273.2	914.6		.487	19.65	0.940
	325.0	14.70	128.2	196.8	8.90	603.0	259.0	862.0	1.051	.653	19.24	
2.180	361.0	13.88	136.4	224.6	8.64	688.2	276.0	964.2	0.982	.621	21.53	7.272
	414.0	13.70	144.7	269.3	8.90	825.4	316.7	1142.1		.632	25.50	0.970
	352.0	15.93	136.4	215.6	9.75	660.2	275.8	936.0	1.017	.731	21.55	
2.250	403.0	15.50	145.0	258.0	9.93	790.0	294.0	1084.	1.020	.719	24.97	7.5
	458.0	15.15	153.4	304.6	10.08	924.0	311.2	1235.		.706	28.47	1.007
	414.0	18.75	154.6	259.4	11.73	794.6	309.0	1104.	1.040	.920	27.10	
2.400	466.0	17.90	164.3	301.7	11.60	921.0	329.8	1251.	1.002	.885	30.73	8.0
	534.0	17.67	174.2	359.8	11.90	1120.	348.7	1451.		.883	35.65	1.079
	454.0	20.56	167.2	286.8	12.97	878.8	334.0	1213.	1.054	1.052	31.03	
2.500	504.2	19.40	178.0	326.2	12.55	998.4	356.0	1355.	0.990	0.997	34.63	8.334
	585.0	19.35	188.7	396.3	13.12	1214.0	377.0	1591.		1.008	40.70	1.118

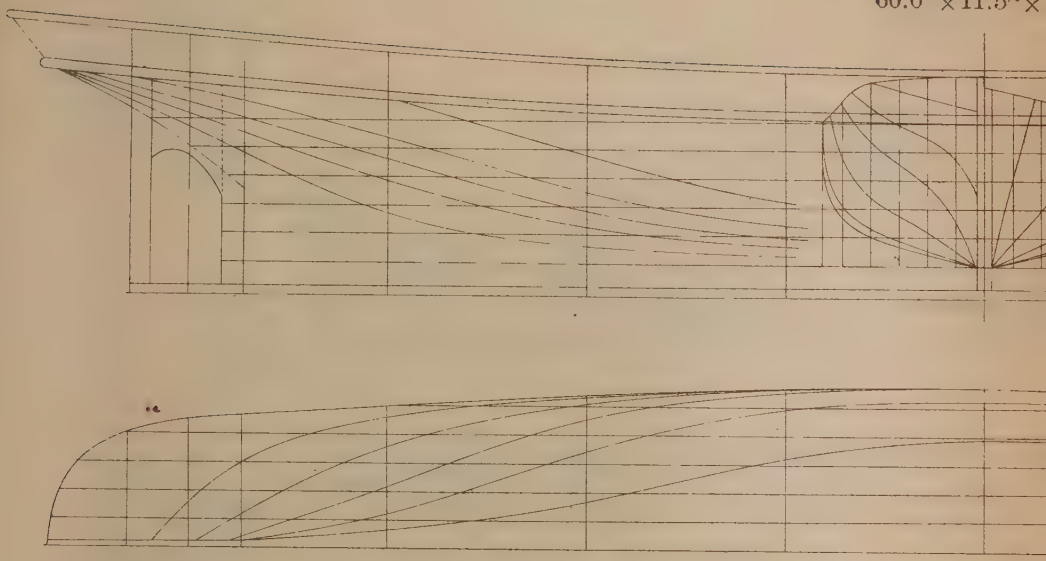
$m.$	$R_t.$	$\frac{R_t.}{\Delta^{K.G.}.}$	$R_f.$	$R_f.$	$\frac{R_r.}{\Delta^{K.G.}.}$	$R_R.$	$R_F.$	$R_T.$	$C.$	$\frac{E.H.P.}{\Delta^{T.}.}$	$E.H.P.$	$V_S.$ $(\frac{v_s}{\sqrt{l_s}}.$
	39.2	1.67	26.8	12.4	0.53	115.0	164.9	279.9	1.040	0.036	3.44	
300	42.4	1.59	28.3	14.1	0.53	130.7	174.9	305.6	0.993	0.035	3.75	4.0
	46.0	1.53	29.8	16.2	0.54	150.2	184.6	334.8		0.035	4.27	0.447
	51.2	2.19	34.0	17.2	0.73	159.5	207.7	367.2	1.042	0.054	5.07	
125	55.4	2.08	36.0	19.4	0.73	179.9	219.8	399.7	1.018	0.051	5.52	4.5
	60.6	2.01	37.8	22.8	0.76	211.3	232.5	443.8		0.051	6.13	3.503
	64.0	2.73	41.4	22.6	0.97	209.6	252.7	462.3	1.043	0.075	7.10	
250	69.4	2.81	44.0	25.4	0.95	235.8	267.3	503.1	1.032	0.072	7.73	5.0
	75.4	2.51	46.5	28.9	0.99	268.2	282.8	551.0		0.070	8.46	0.559
	79.0	3.37	50.0	29.0	1.24	268.8	300.7	569.5	1.043	0.102	9.61	
375	85.4	3.21*	52.8	32.6	1.23	302.3	318.3	620.6	1.043	0.098	10.48	5.5
	92.0	3.06	55.8	36.2	1.20	335.7	336.7	672.4		0.093	11.35	0.615
	96.0	4.10	58.7	37.3	1.59	345.8	352.7	698.5	1.043	0.136	12.87	
500	103.4	3.89	62.2	41.2	1.55	382.0	373.2	755.2	1.050	0.130	14.00	6.0
	111.4	3.72	65.8	45.6	1.51	422.7	394.7	817.4		0.124	15.05	0.671
	115.5	4.92	69.0	46.3	1.98	429.3	406.5	835.8	1.042	0.176	16.68	
625	125.2	4.70	73.0	52.2	1.96	484.0	430.2	914.2	1.034	0.169	18.20	6.5
	135.6	4.51	77.2	58.4	1.94	541.4	455.0	966.4		0.164	19.88	0.727
	139.0	5.34	79.4	59.6	2.54	552.2	466.8	1019.0	1.029	0.231	21.90	
750	152.4	5.73	84.2	68.2	2.56	632.0	494.0	1126.0	1.053	0.223	24.20	7.0
	163.0	5.42	89.0	74.0	2.46	686.0	522.6	1208.5		0.214	25.97	0.7825
	167.2	7.14	90.8	76.4	3.22	708.2	532.0	1240.2	1.035	0.302	28.57	
875	182.8	6.87	96.3	86.5	3.25	802.0	562.8	1364.8	1.053	0.292	31.40	7.5
	195.4	6.49	102.0	93.4	3.10	865.8	595.4	1461.2		0.277	33.62	0.8385
	202.0	8.63	102.9	99.1	4.24	918.6	595.4	1514.0	1.033	0.394	37.20	
000	220.8	8.30	108.8	112.0	4.21	1038.5	630.6	1669.1	1.034	0.382	41.00	8.0
	240.0	7.98	115.2	124.8	4.14	1157.0	667.0	1824.0		0.368	44.80	0.895
	253.8	10.83	116.0	137.8	5.89	1278.0	666.5	1943.5	1.004	0.536	50.70	
125	284.0	10.67	123.0	161.0	6.04	1493.0	704.6	2197.6	1.013	0.533	57.34	8.5
	314.0	10.43	130.0	184.0	6.12	1706.0	745.4	2451.4		0.526	63.92	0.950
	—	—	—	—	—	—	—	—		—	—	
250	370.0	13.90	137.3	232.7	8.74	2157.0	781.6	2938.6	0.957	0.755	81.10	9.0
	431.0	14.30	145.2	285.8	9.48	2650.0	827.4	3477.4		0.790	96.00	1.006
	—	—	—	—	—	—	—	—		—	—	
375	464.0	17.45	152.7	311.3	11.70	2886.0	864.8	3750.8	0.991	1.017	109.40	9.5
	564.0	18.75	161.0	403.6	13.40	3734.0	914.5	4648.5		1.115	135.50	1.062

V_m.	R_t.	$\frac{R_t.}{\Delta^{K.G.}.}$	R_f.	R_r.	$\frac{R_r.}{\Delta^{K.G.}.}$	R_R.	R_F.	R_T.	C.	$\frac{E.H.P.}{\Delta^{T.}}$	$E.H.P.$	V_s. $(\frac{V_s}{\sqrt{L}})$
1.046	54.0	1.90	34.7	19.3	0.68	136.0	155.1	291.1	1.038	0.041	3.57	4.0
	55.8	1.82	36.8	22.0	0.68	155.2	164.1	319.3		0.040	3.92	0.468
	—	—	—	—	—	—	—	—		—	—	
1.177	77.4	2.51	43.8	27.6	0.97	194.6	195.3	389.9	1.042	0.062	5.38	4.5
	77.4	2.39	46.2	31.2	0.96	220.0	206.6	426.6		0.059	5.90	0.527
	—	—	—	—	—	—	—	—		—	—	
1.308	91.8	3.23	53.4	38.4	1.35	271.4	237.5	508.9	1.077	0.091	7.94	5.0
	98.8	3.05	56.7	42.1	1.30	296.7	251.3	548.0		0.085	8.40	0.644
	—	—	—	—	—	—	—	—		—	—	
1.440	114.3	4.02	64.2	50.1	1.76	356.2	282.7	638.9	1.059	0.124	10.78	5.5
	124.0	3.82	68.0	56.0	1.73	394.7	299.2	693.9		0.119	11.71	0 644
	—	—	—	—	—	—	—	—		—	—	
1.570	140.7	4.95	76.0	64.7	2.28	456.0	331.5	787.5	1.053	0.167	14.50	6.0
	152.0	4.69	80.7	71.3	2.20	502.6	350.7	853.3		0.158	15.72	0.702
	—	—	—	—	—	—	—	—		—	—	
1.700	170.0	5.98	89.0	81.0	2.85	671.0	382.1	953.1	1.053	0.218	19.01	6.5
	183.2	5.65	94.0	89.2	2.75	628.6	404.5	1033.		0.207	20.60	0.761
	—	—	—	—	—	—	—	—		—	—	
1.830	204.0	7.18	102.8	101.2	3.56	713.8	438.8	1153.	1.048	0.284	24.77	7.0
	220.6	6.80	108.4	112.2	3.46	791.4	464.4	1256.		0.272	27.00	0.820
	—	—	—	—	—	—	—	—		—	—	
1.963	245.0	8.63	118.2	126.8	4.46	894.0	500.0	1394.	1.053	0.369	32.10	7.5
	264.0	8.14	124.4	139.6	4.30	934.0	529.2	1513.		0.351	34.83	0.878
	—	—	—	—	—	—	—	—		—	—	
2.094	296.6	10.43	134.6	162.0	5.70	1143.	560.0	1703.	1.042	0.480	41.80	8.0
	321.6	9.91	141.6	180.0	5.50	1270.	592.7	1863.		0.461	45.75	0.937
	—	—	—	—	—	—	—	—		—	—	
2.224	365.0	12.85	142.7	222.3	7.81	1567.	626.0	2193.	1.054	0.657	57.22	8.5
	401.0	12.37	159.0	242.0	7.46	1705.	662.4	2368.		0.623	61.80	0.995
	—	—	—	—	—	—	—	—		—	—	
2.355	437.0	15.37	168.0	269.0	9.47	1897.	695.0	2592.	1.988	0.823	71.60	9.0
	497.0	15.32	179.0	320.0	9.87	2257.	735.0	2992.		0.832	82.60	1.054
	—	—	—	—	—	—	—	—		—	—	
2.485	504.0	17.75	186.6	317.4	11.17	2237.	768.2	3005.	0.993	1.006	87.58	9.5
	574.0	17.70	197.0	377.0	11.63	2657.	813.0	3470.		1.012	101.15	1.112
	—	—	—	—	—	—	—	—		—	—	

Fig. I.

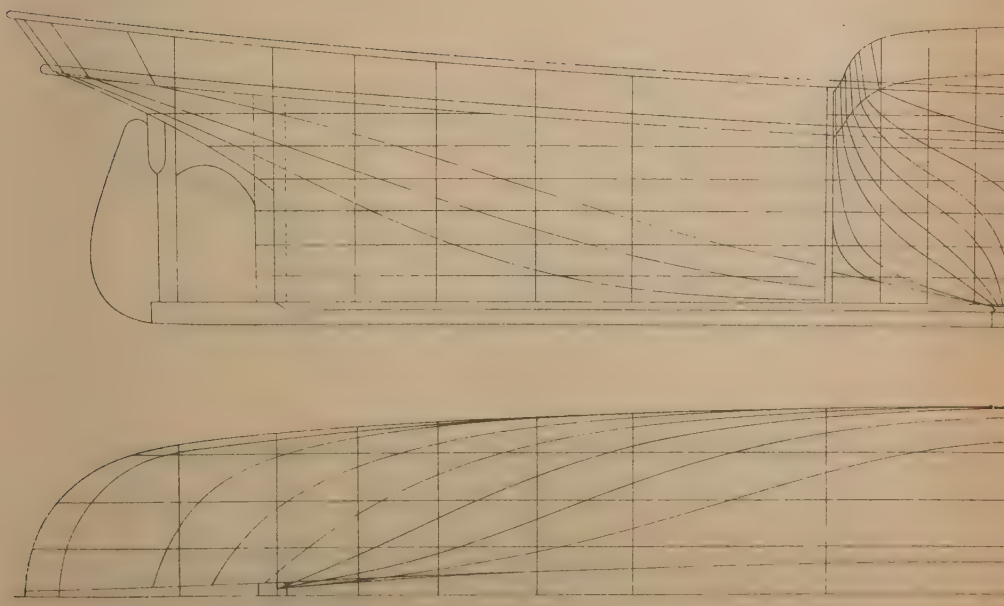
I

$60.0^{R} \times 11.5^{R} \times$



Fi

$56.0^{R} \times 1$



Fi

50′ – 3″ × 12

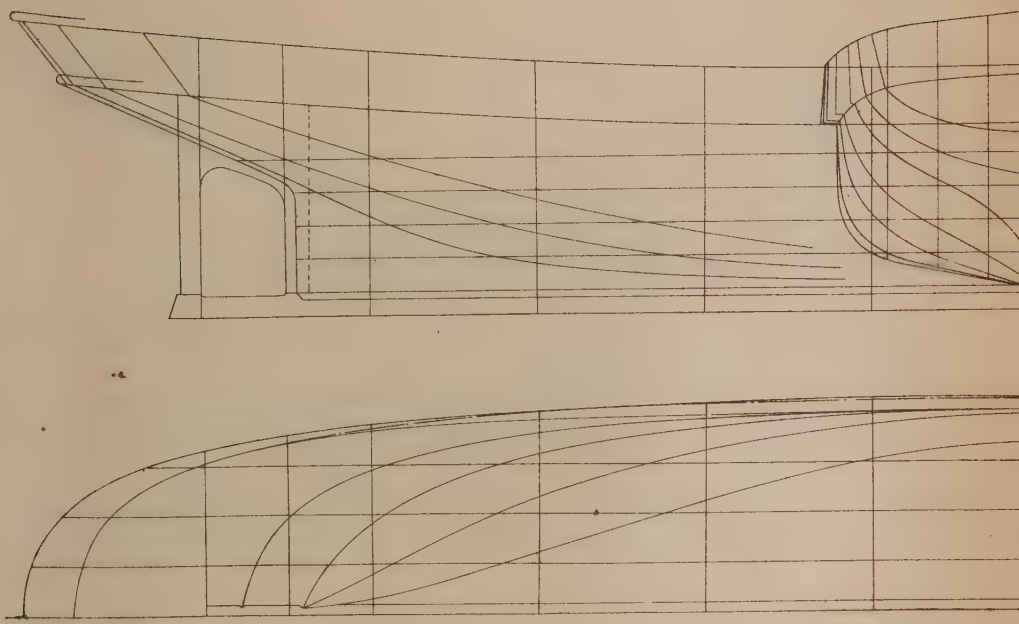


Fig.

IV

67′ – 0″ × 16′ –

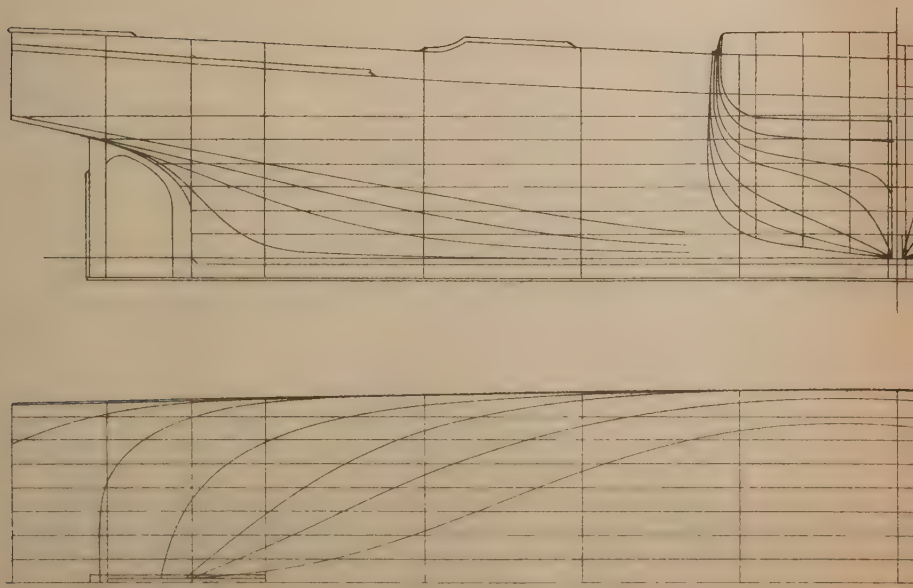


Fig. I.

V

$60.0^{R} \times 12.0^{R}$

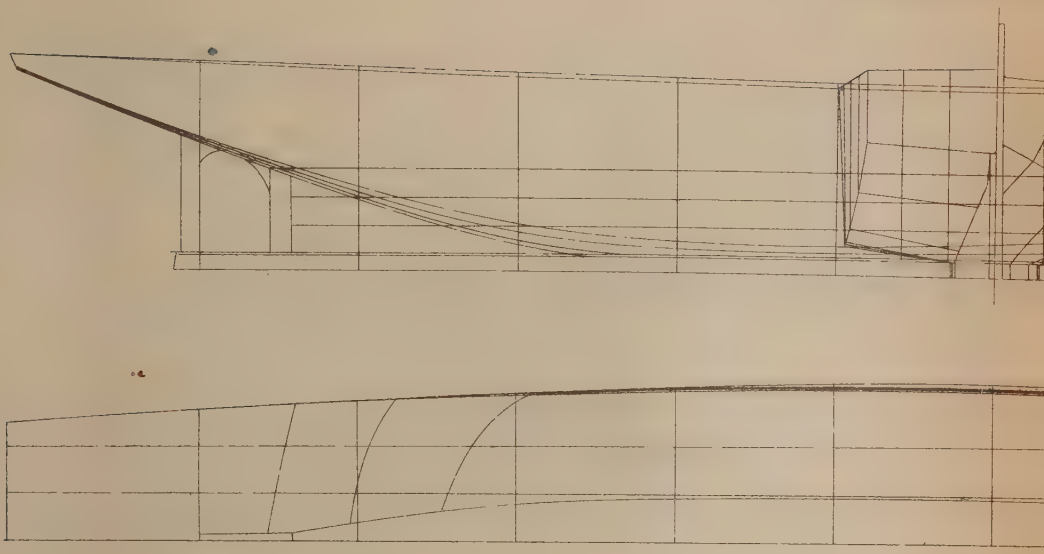


Fig. I.

VI

$55' - 6'' \times 12' - 6''$

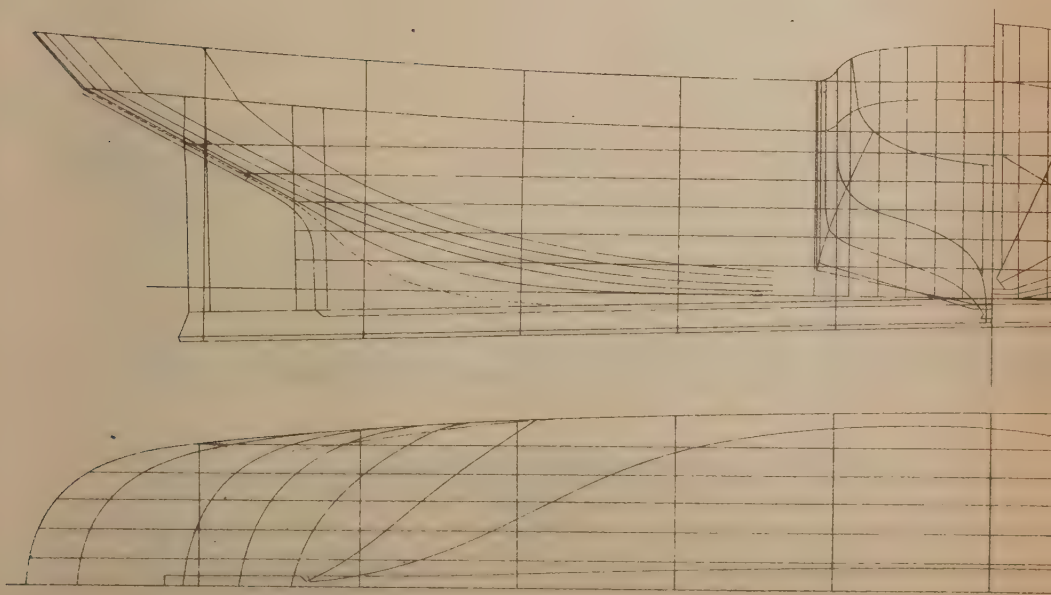


Fig. I.

VII

80′−0″×14′−0″×

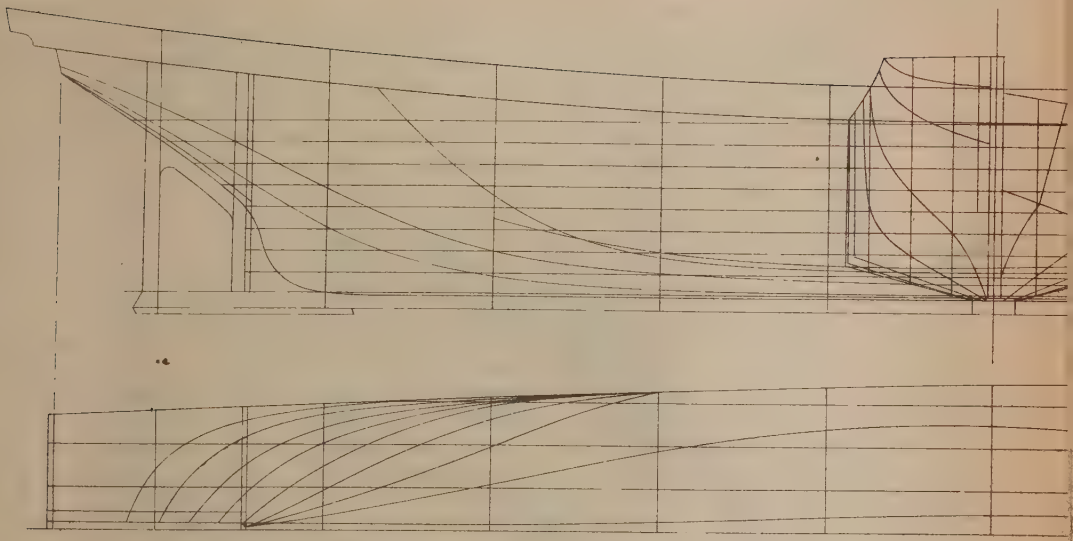


Fig. I.

VIII

73′−0″×14′−0″×

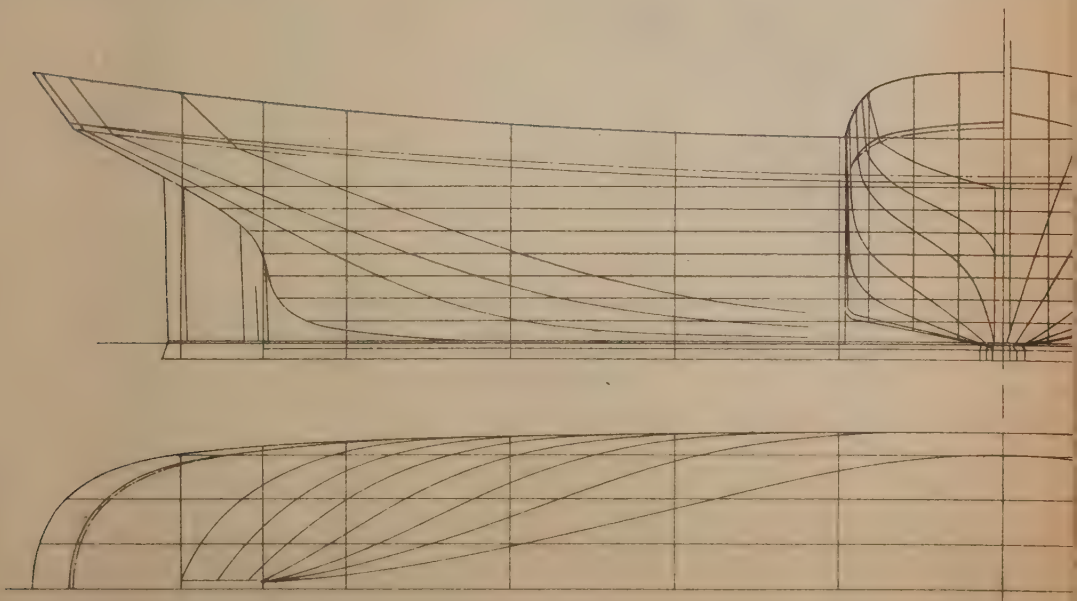
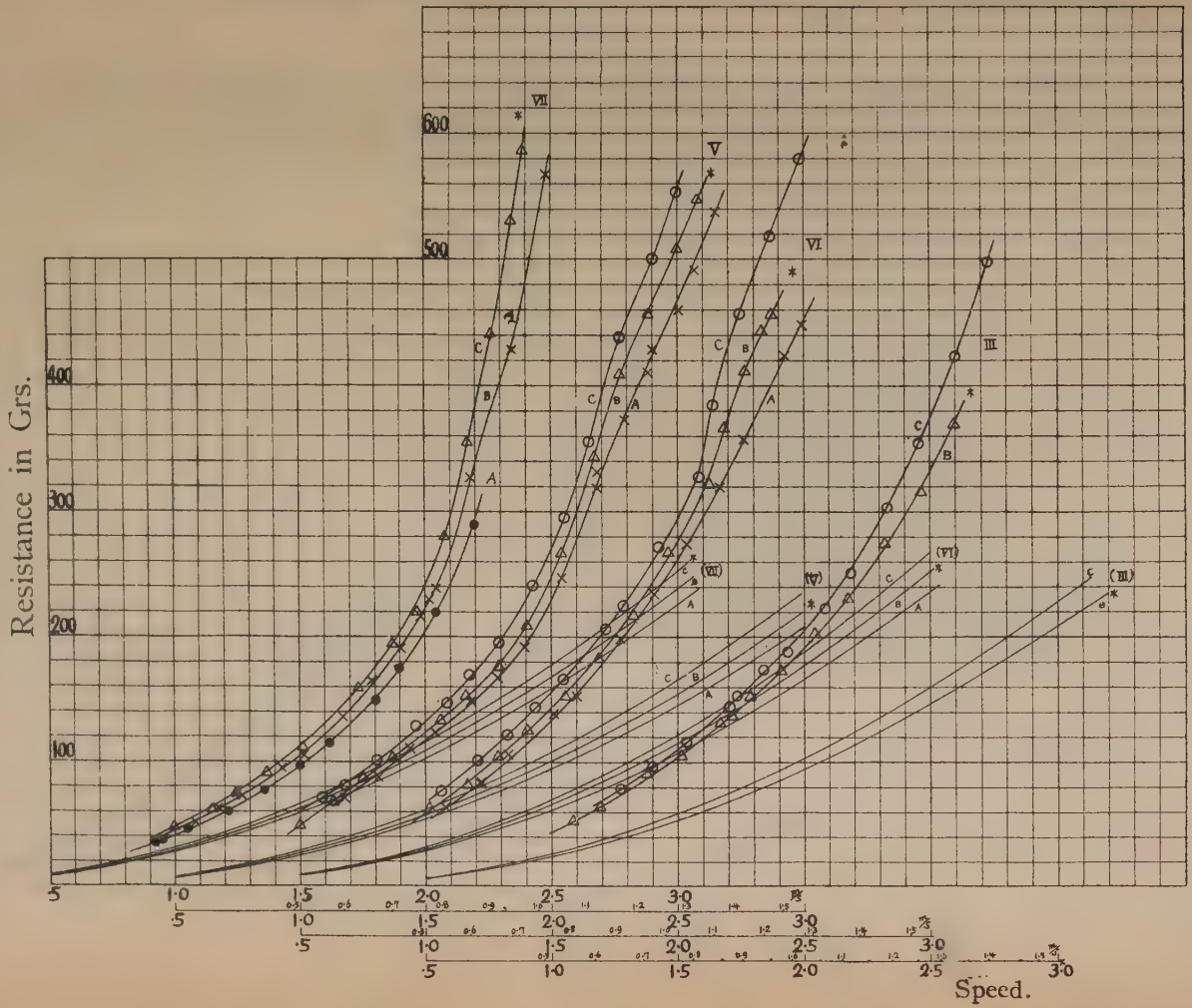
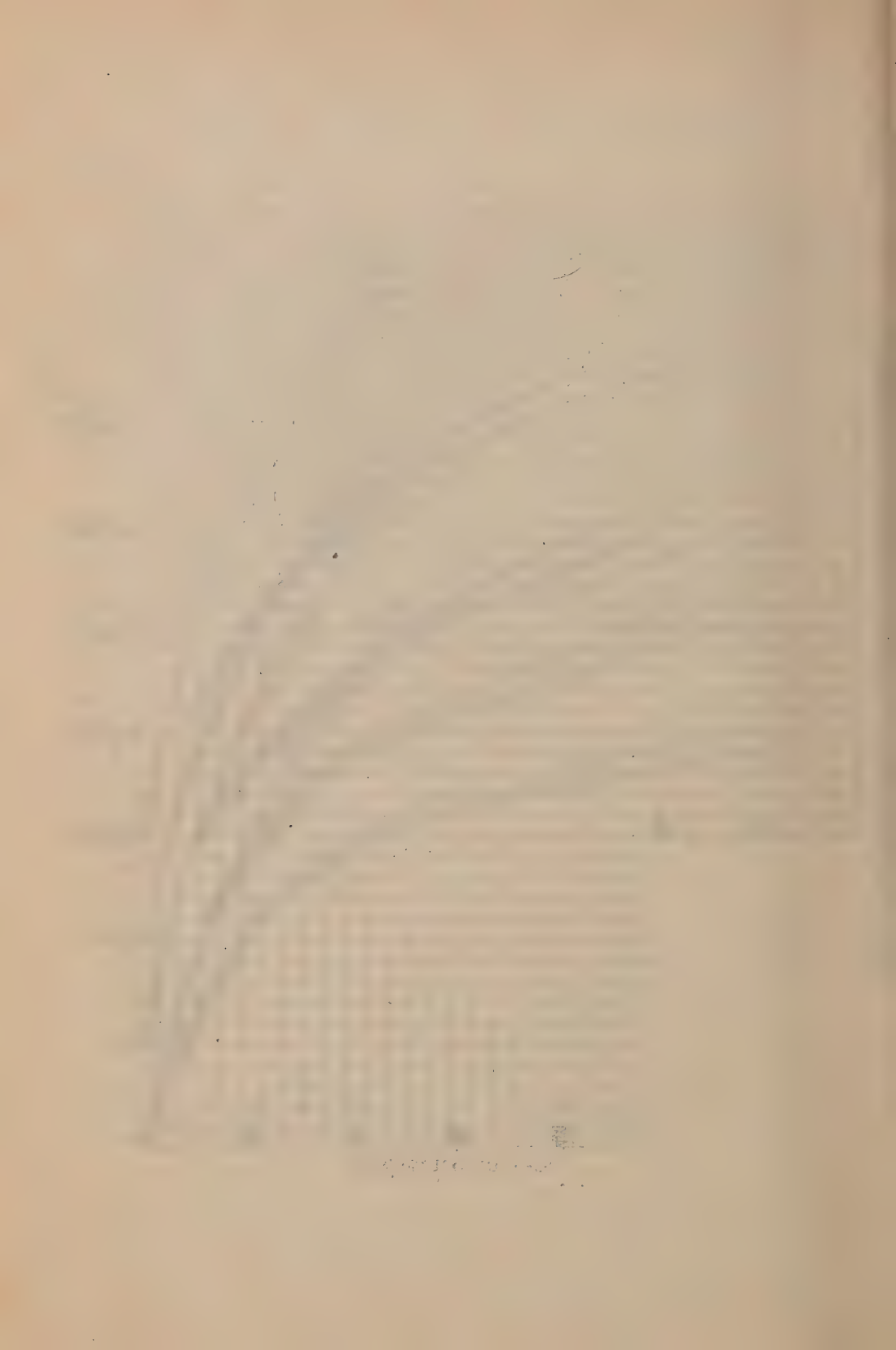


Fig. 2. A. (VII), (V), (VI), (III). Frictional Resistance Calculated.





(II), (VII), (IV), (I)····Frictional Resistance Calculated.

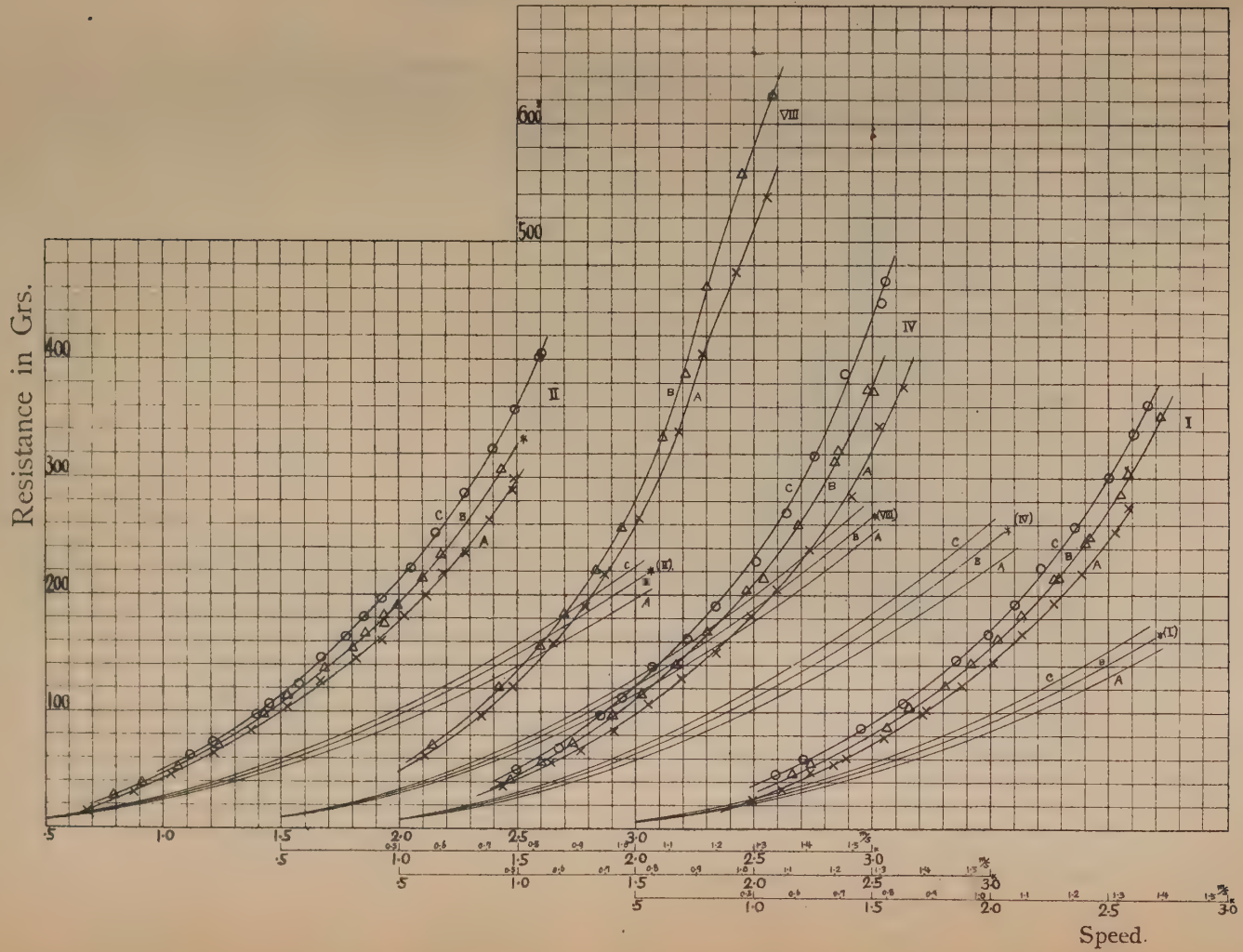


Fig. 3.

Total Resistance at Ordinary Draft.

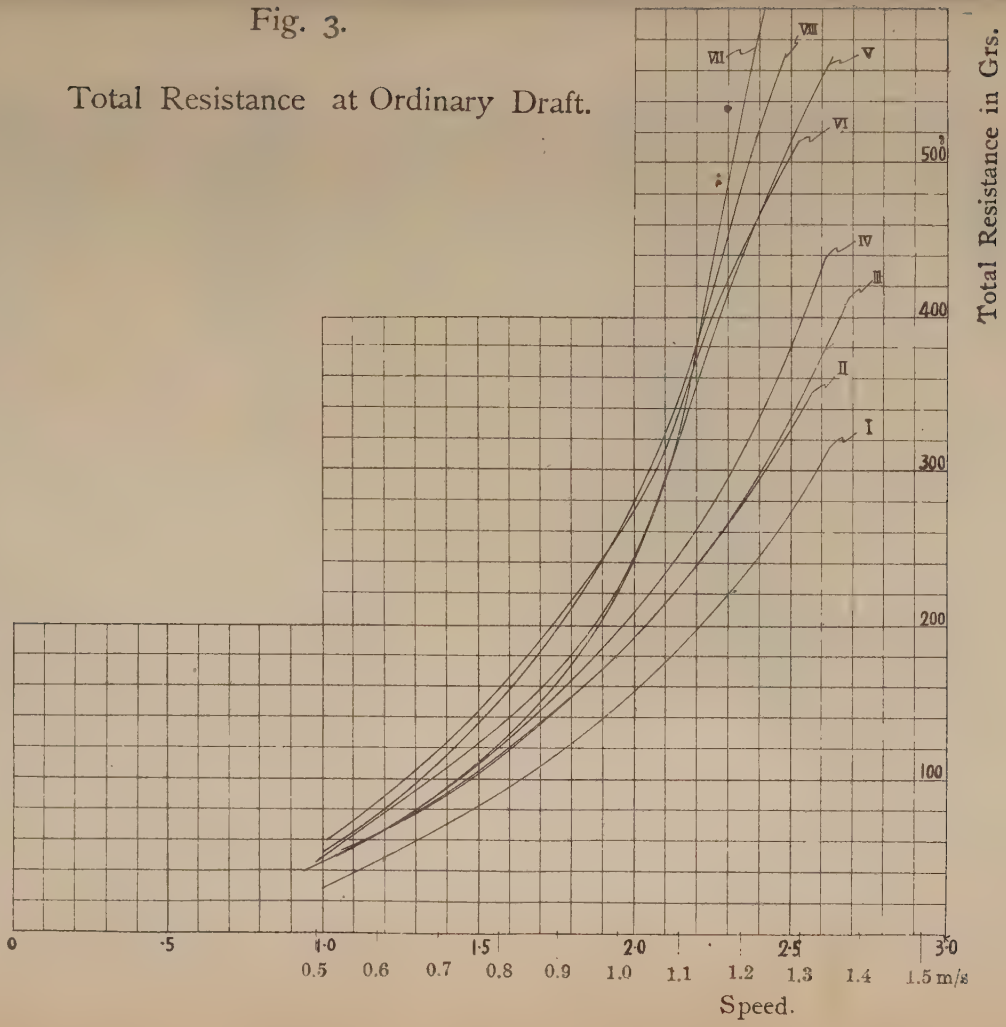


Fig. 4.

Frictional Resistance at Ordinary Draft.

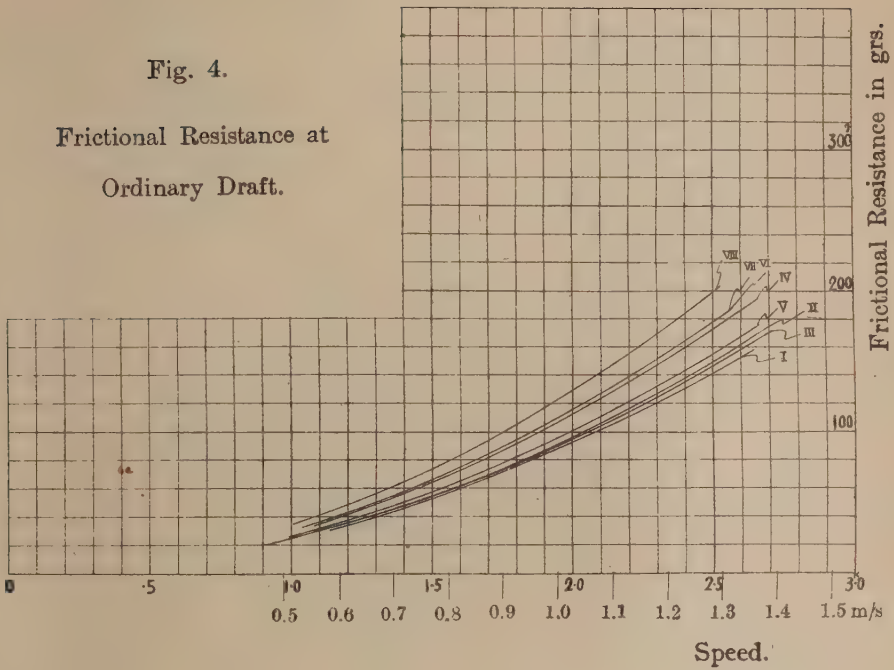


Fig. 5.

Residuary Resistance of Models at Ordinary Draft.

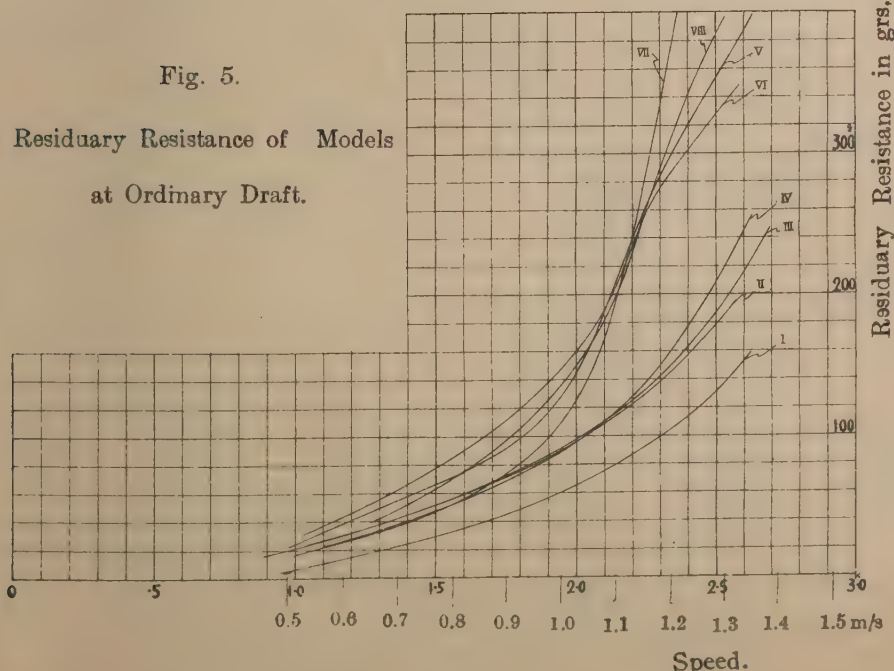


Fig. 6.

Effective Horse Power of Actual Ships.

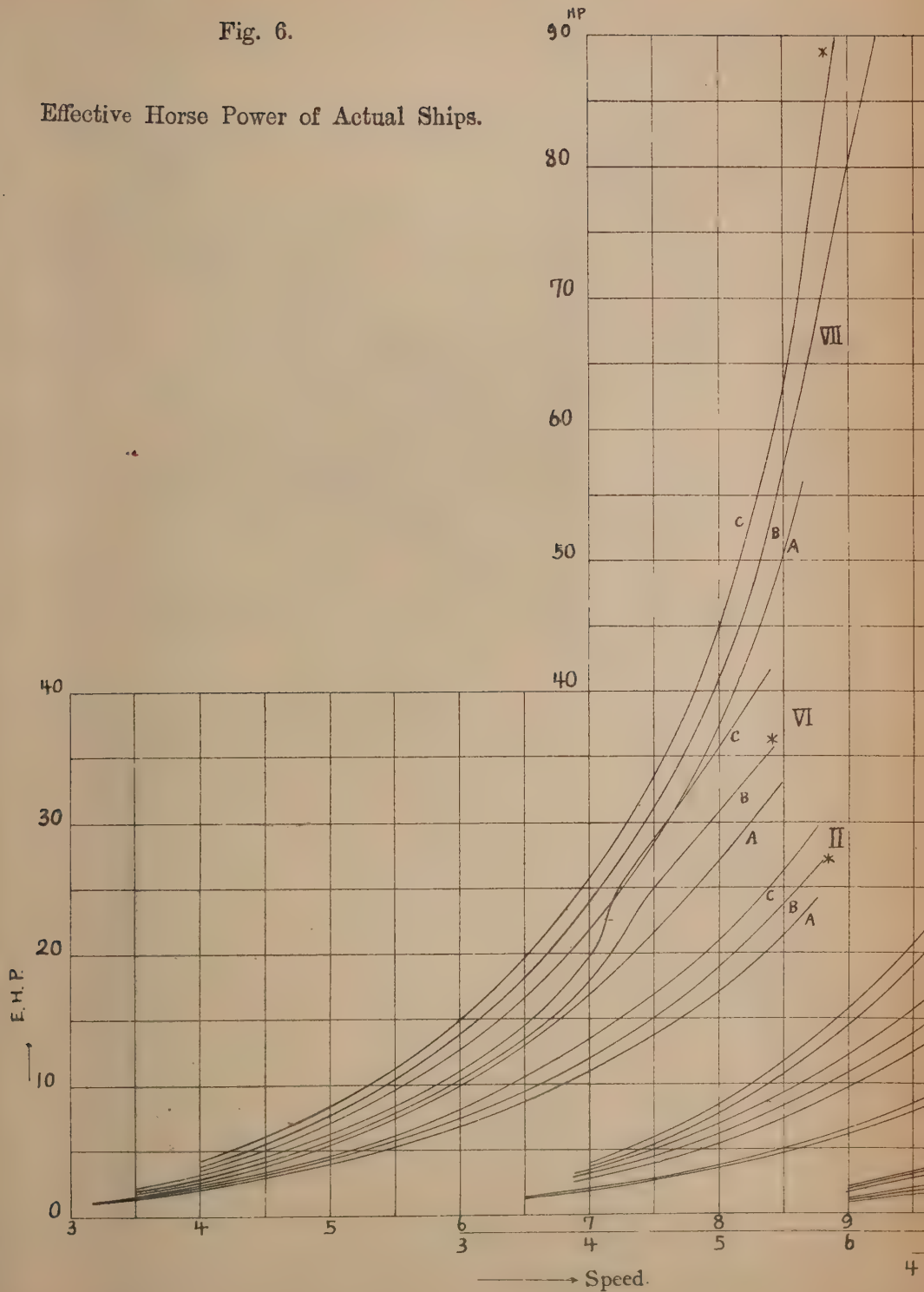


Fig. 7. E.H.P. Curves for Ordinary Draft.

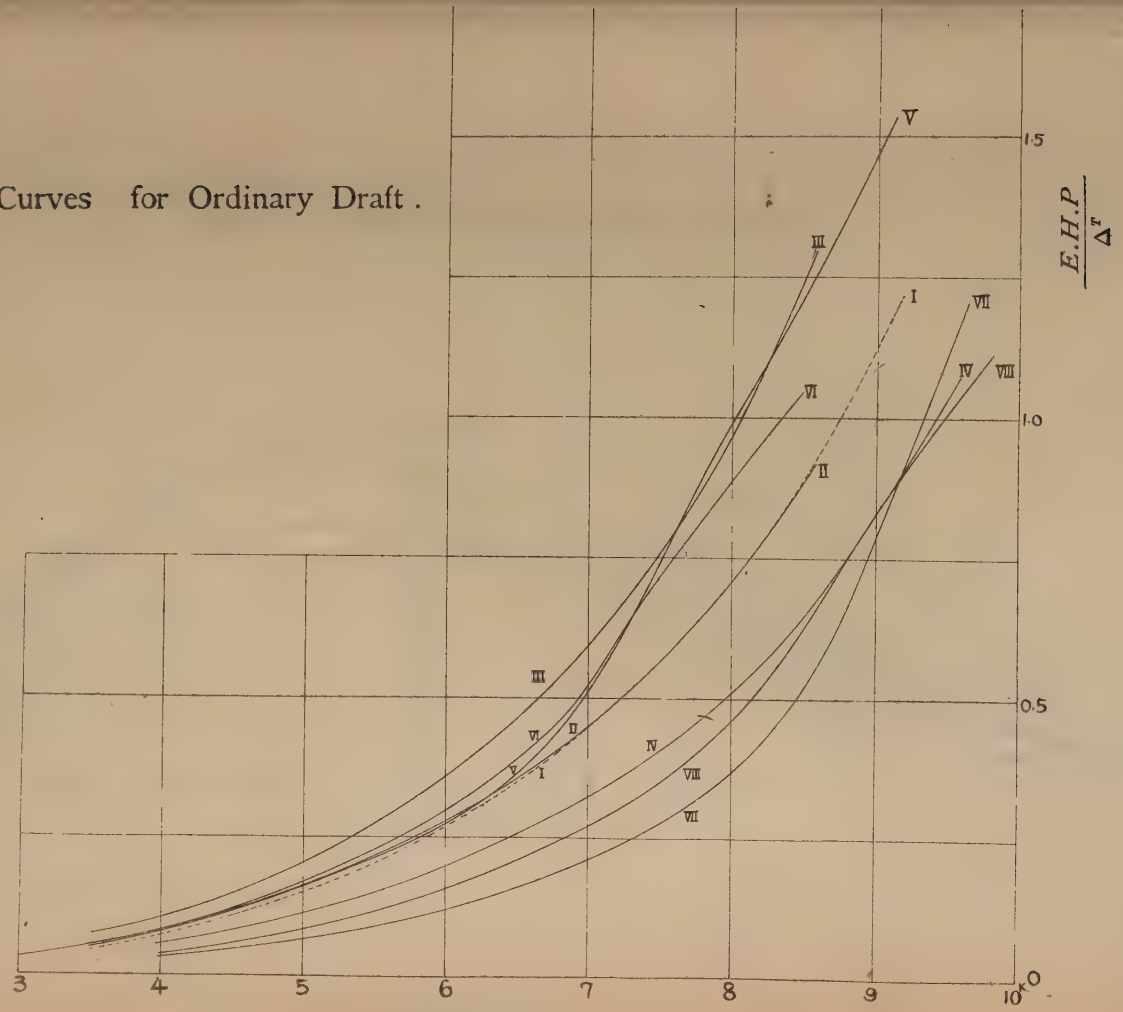


Fig. 8. Area at Square Stations of Models.

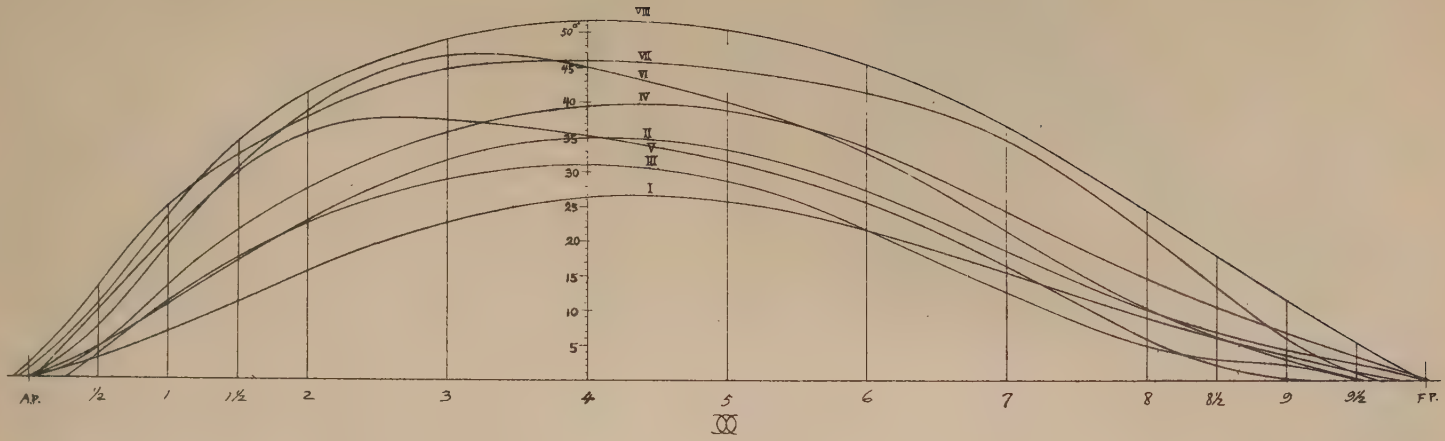


Fig. 9. Girth Curves.

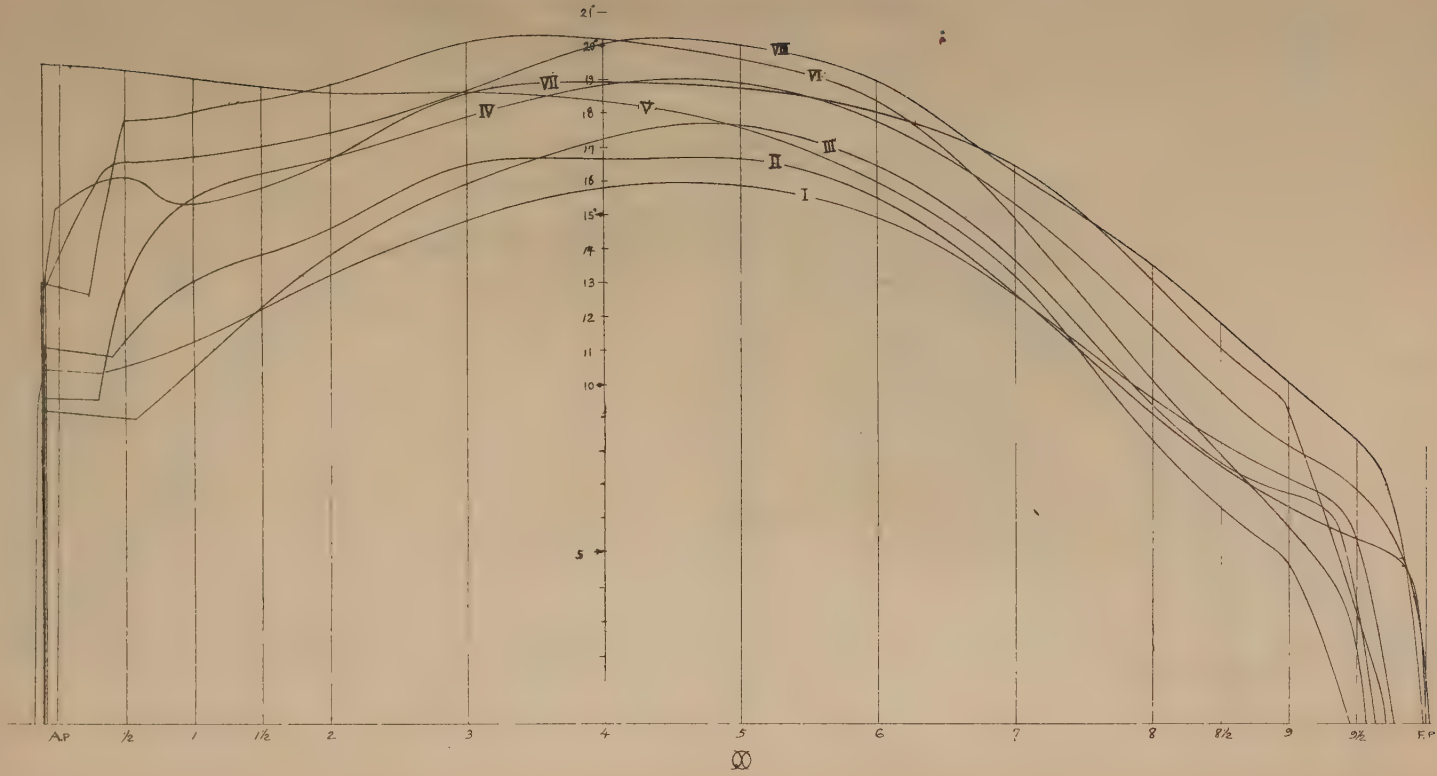


Fig. 10. Breadths of Water Planes.

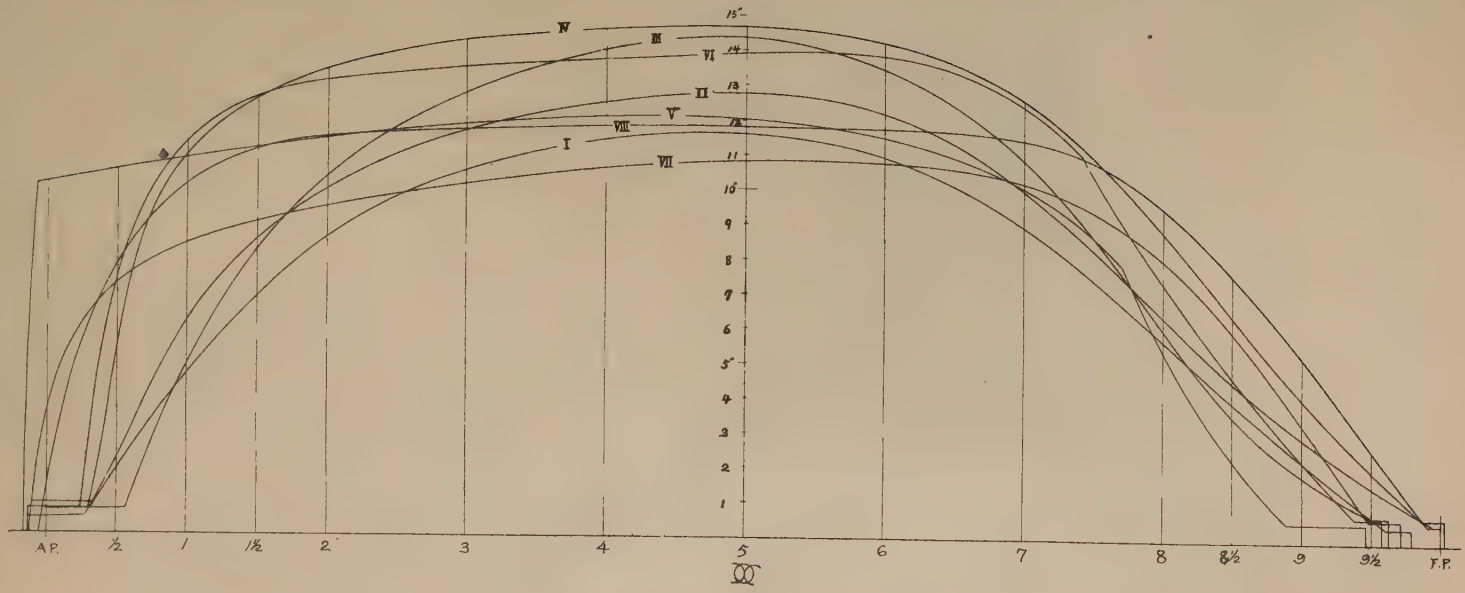


Fig. 11.

$\frac{R_t}{\Delta^{K.G.}}$ at Equal Draft.

A
Draft = 9.17cm

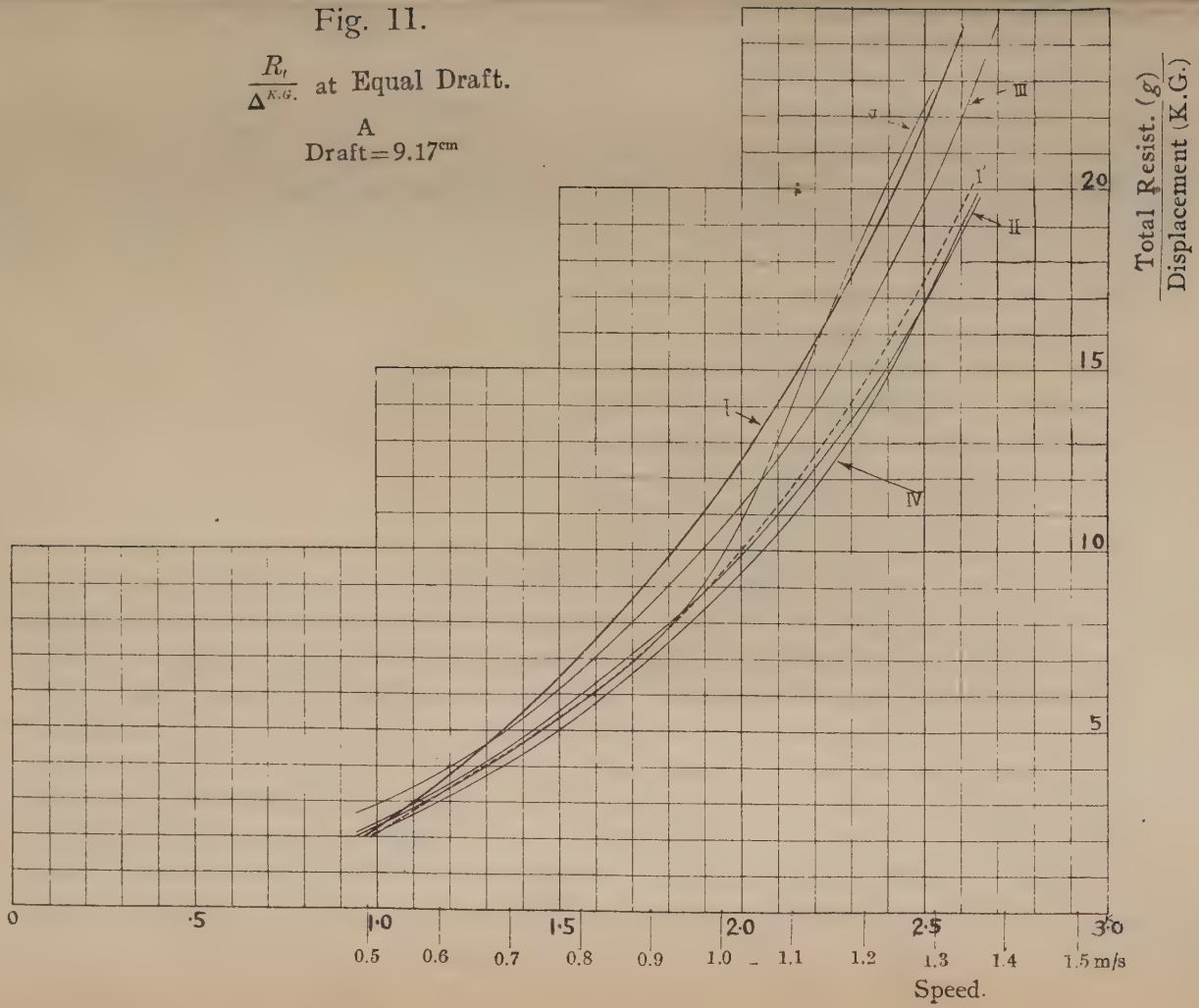
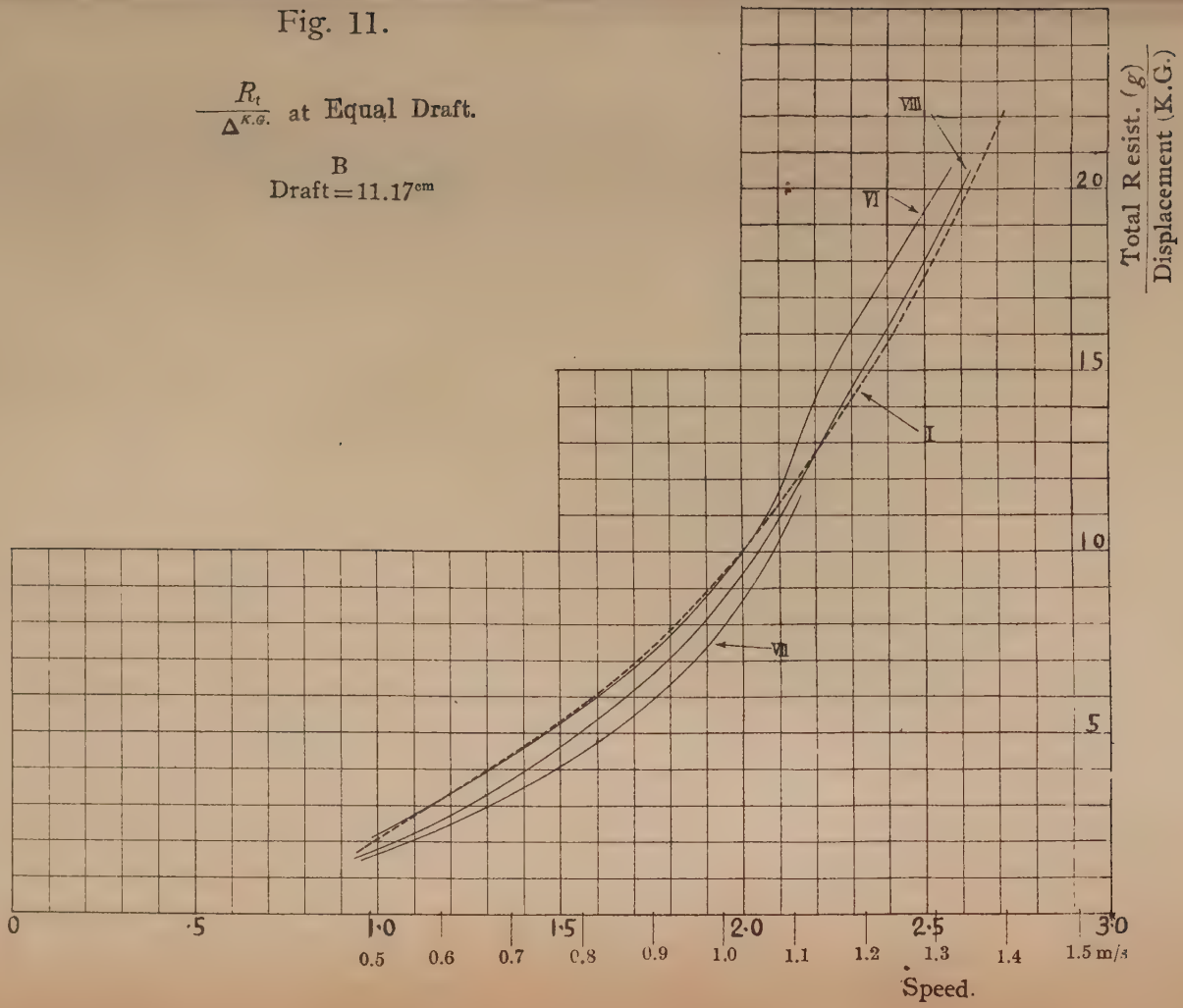
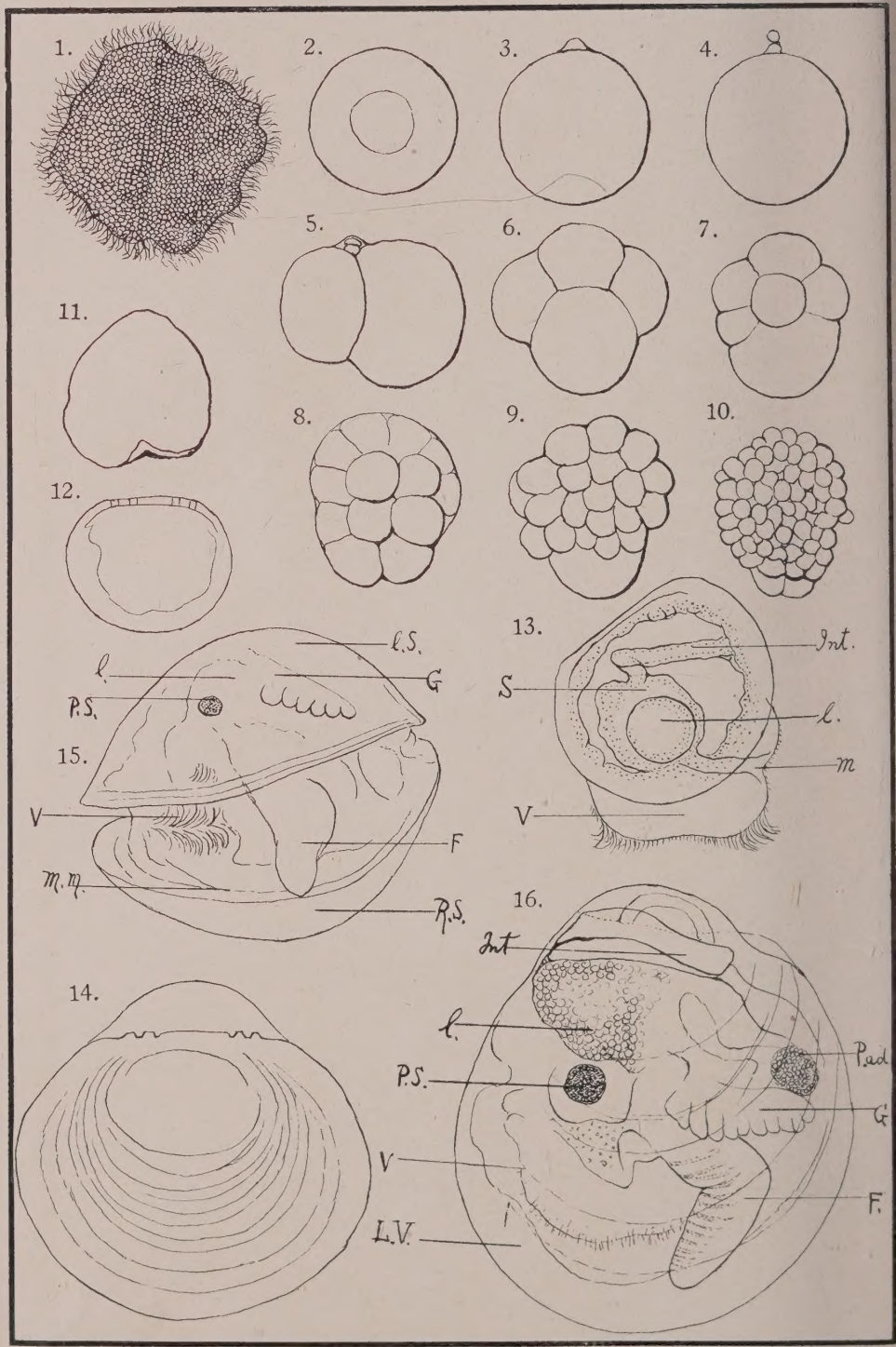


Fig. 11.

$\frac{R_t}{\Delta^{K.G.}}$ at Equal Draft.

B
Draft = 11.17cm

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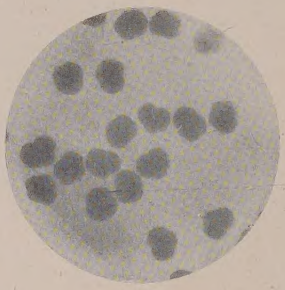

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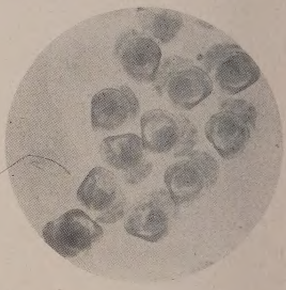

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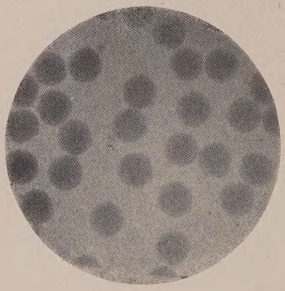

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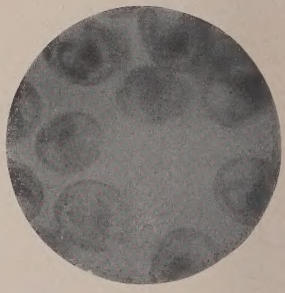

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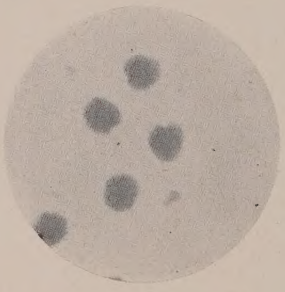

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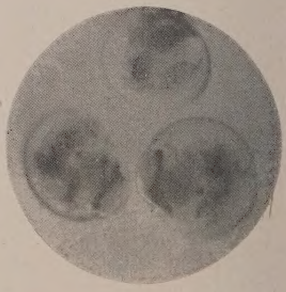

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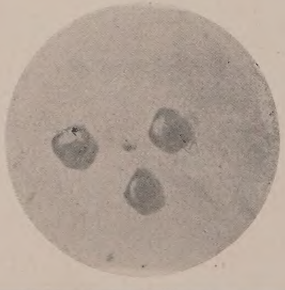

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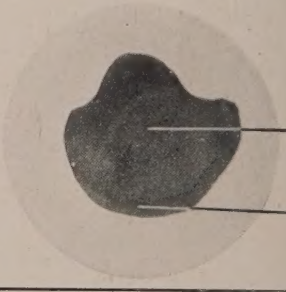

H. SENÔ Photo.